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PROCEEDINGS

OF THE

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

VOLUME XIII.—1886-87.

EDITED BY

THOMAS COLE,

ASSOC. M. INST. C.E.

(Secretary of the Association)

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CONTENTS.

	PAGE
List of Officers	v
List of Members	vii
List of Towns and Districts Represented	xvi
Parliamentary Committee	xxi
Rules	xxii
Annual Report and Financial Statement for Year ending April 30th, 1887	1
Appointment of Auditors	5
„ „ Scrutineers	5
„ „ Acting District Secretaries	5

District Meetings—

Meeting at Rochester:

Public Health Act, 1875,—The 150th Section.—Remarks on its Operation, with Suggested Remedies of its Defects. Wm. Spinks, Assoc. M. Inst. C.E.	8
Discussion	25
Supplemental Remarks	42
Correspondence	45
Visit to Works	48
Digest of Cases bearing on Sections 150, 152, 257, and 268	49

Meeting at Walthamstow:

Visit to Works	83

Meeting at West Hartlepool:

The Construction and Maintenance of Macadamised Roads. J. W. Brown, C.E., F.G.S.	90
Hartlepool Headland Protection. Hugh Mair, C.E.	101
Discussion	107
Visits to Works	109

Meeting at Warrington:

Discussion	110
Correspondence	117
Visit to Works	125

27365

DISTRICT MEETINGS (*continued*)— PAGE

MEETING AT PORTSMOUTH:

The Drainage of Portsmouth. H. P. Boulnois, M. Inst. C.E. .. 126

The New Town Hall, Portsmouth. H. P. Boulnois, M. Inst. C.E. 133

Discussion 138

Visit to Works 141

MEETING AT KIDDERMINSTER:

Description of the Sanitary Works of Kidderminster. A. Comber, C.E. 142

Discussion 159

Visits to Works 164

MEETING AT BOLTON:

Description of the Bolton Sewage Works. J. Proctor, M. Inst. C.E. 166

Visit to Works 176

ANNUAL MEETING AT LEICESTER—

President's Address 177

On Asphalte and Concrete Foot-Pavements. Geo. R. Strachan, Assoc. M. Inst. C.E. 192

Discussion 205

Correspondence 212

Refuse Destructors and their Results up to the present time. C. Jones, Assoc. Inst. C.E. 216

Discussion 255

An Examination of some recent Experiments on Sewage Treatment made, by W. J. Dibdin, Esq., F.C.S., F.I.C., for the Metropolitan Board of Works. R. W. Peregrine Birch, M. Inst. C.E. 261

Discussion 264

Cremation. W. Eassie, C.E. 274

Discussion 283

Jennings and Brewer's Patent Electro Mechanical Apparatus for Indicating and Registering Varying Levels of Liquids in Reservoirs, Sewers and elsewhere, and which is also applicable for Denoting the Direction of Air Currents. Walter Jennings. 289

Discussion 295

Visit to Works 296

APPENDIX—

Statistics relating to the Keep of Horses. John T. Eayrs, Assoc. M. Inst. C.E. 299

EXAMINATIONS 305

BOARD OF EXAMINERS 314

CERTIFICATED CANDIDATES 315

MEMOIRS OF DECEASED MEMBERS 316

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PARKER, J., Assoc. M. Inst. C.E.	Surveyor to the Basford Union, Rural Sanitary Authority, Nottingham.
PARKER, J., Assoc. M. Inst. C.E.	City Surveyor, Hereford.
PARKINSON, JAS.	Surveyor to the Local Board, Turton, near Bolton.
PARRY, A. W., Assoc. M. Inst. C.E. (*Member of Council.*)	Borough Surveyor, Reading.
PATTISON, J., jun.	Borough Surveyor, Newcastle-under-Lyme.
PENTY, W. G.	Surveyor to the Rural Sanitary Authority, York.
PERRY, WM.	Westminster Chambers, Corporation Street, Birmingham.
PETREE, J.	Borough Surveyor, Jarrow.
PICKERING, RICHARD	11, Lowther Street, Whitehaven.
PILDITCH, J. T.	Surveyor to the Parish of Battersea.
PLATT, S. S., Assoc. M. Inst. C.E. (*Member of Council.*)	Borough Surveyor, Rochdale, *Hon. Secretary* Lancashire and Cheshire District.
POLLARD, J., Assoc. M. Inst. C.E.	Late Surveyor to the Local Board, Hendon. 7, Gt. Queen Street, Westminster.
PORTER, R.	Borough Surveyor, Wakefield.
PRICE, JOHN, Assoc. M. Inst. C.E.	Surveyor to the Local Board, Toxteth Park, Liverpool.
PRITCHARD, EDWARD, M. Inst. C.E. (*Past President.*)	37, Waterloo Street, Birmingham, and 2 Storey's Gate, S.W.
PROCTOR, J., M. Inst. C.E. ..	Borough Surveyor (Consulting), Bolton, Lancashire.
PURNELL, E. J.	City Surveyor, Coventry, Warwickshire.
RADFORD, J. C.	District Surveyor, Putney.
RAMSDEN, A.	Surveyor to the Local Board, Chiswick.
READ, RICHARD, Assoc. M. Inst. C.E. (*Member of Council.*)	City Surveyor, Gloucester.
RICHARDSON, JAS.	Urban Sanitary Authority, Stamford.
RICKETTS, F. J.	124, Mansfield Road, N.W.
ROBINSON, W. J., Assoc. M. Inst. C.E.	City Surveyor, Londonderry.
ROBSON, O. C., Assoc. M. Inst. C.E. (*Member of Council.*)	Surveyor to the Local Board, Willesden, Middlesex; *Hon. Secretary*, Home Counties District.
ROTHWELL, E.	Late Surveyor to the Local Board, Norden near Rochdale. Tramways Co., Rochdale.
ROUNTHWAITE, R. S.	Borough Engineer, Sunderland.
ROWE, WM.	Tiverton, Devon.
ROWLEY, S. F.	Surveyor to the Local Board, Tipton.
ROYLE, H., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Stretford, Lancashire.
RUMBLE, F. J.	Surveyor to the Local Board, New Barnet.

Sadler, G. W.	Surveyor to the Sanitary Authority, Cheltenham.
Savage, Wm. Hy.	Surveyor to the Local Board, East Ham.
Scott, R. S.	Surveyor to the Local Board, Bishop's Stortford.
Sharman, E.	Surveyor to the Local Board, Wellingborough, Northamptonshire.
Sheppard, Geo.	Borough Surveyor, Newark.
Shuttleworth, F. H., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Littleborough, Lancashire.
Silcock, E. J., A. M.Inst.C.E.	Borough Surveyor, King's Lynn.
Simpson, John, jun.	Late Surveyor to the Local Board, Matlock.
Smith, G. F.	Surveyor to the Local Board, Milverton, Warwickshire.
Smith, J. W. M.	Borough Surveyor, Wrexham, Denbighshire, *Hon. Secretary*, Wales District.
Smythe, F.	Surveyor to the Rural Sanitary Authority, Solihull.
Spencer, J. P., A.M.Inst.C.E.	50, Side, Newcastle-on-Tyne.
Spinks, W., Assoc.M.Inst.C.E.	Surveyor to the Local Board, Dukinfield.
Stafford, J. E., Assoc. M. Inst. C.E.	Borough Engineer, Burnley.
Stainthorpe, T. W.	Surveyor to the Eston District Local Board.
Stansfield-Brun, J., Assoc. M. Inst. C.E.	Late Surveyor to the Local Board, Oldbury. 186, Kensal Road, Westbourne Park.
Stevens, George	Borough Surveyor, Godmanchester.
Stewart, A., Assoc. M. Inst. C.E.	Surveyor to the Rural Sanitary Authority, Maldon.
Stewart, Wm.	Surveyor to the Local Board, Rugby.
Stokoe, J.	Surveyor to the Local Board, Altrincham.
Strachan, G. R., Assoc. M. Inst. C.E.	Surveyor, Chelsea.
Stringfellow, H. W.	City Surveyor, Chichester.
Stubbs, Wm., Assoc. M. Inst. C.E.	Borough Surveyor, Over Darwen.
Swarbrick, Joseph, Assoc. M. Inst. C.E.	Surveyor to the Local Board, Withington, near Manchester.
Swindlehurst, J. E., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Rawtenstall.
Sykes, Ed.	Surveyor to the Local Board, Reddish.
Tanner, W.	County Surveyor, Glamorganshire, Newport.
Taylor, H., A. M. Inst. C.E.	Surveyor to the Local Board, Clevedon, Somerset.
Thomas, John	Surveyor to the Rural Sanitary Authority, Swansea.
Thomas, W., Assoc.M.Inst.C.E.	Borough Surveyor, Dorchester.
Thomas, W. E. C., Assoc. M. Inst. C.E.	Surveyor to the Rural Sanitary Authority, Neath.
Thompson, R.	Surveyor to the Local Board, Waterloo, near Liverpool.
Thomson, P. W., Assoc. M. Inst. C.E.	Late Surveyor to the Local Boards of Willington Quay and Wallsend, Northumberland.
Thorburn, T. C.	Borough Surveyor, Birkenhead.
Thorrold, S. E.	Late Surveyor to the Local Board, South Stockton.
TILL, W. S., M. Inst. C.E. .. (*Past President.*)	Borough Engineer, Birmingham.
Tomes, C.	Borough Surveyor, Eastbourne.
Trapp, S. C.	88, Mosley Street, Manchester.
Tudor, E. C. B.	Surveyor to the Local Board, Goole, Yorkshire.
Tulloch, F. H., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Southend.
Turner, L.	Surveyor to the Rural Sanitary Authority, Headington, Oxford.

VAWSER, R., M. Inst. C.E. (*Past President.*)	17, Cooper Street, Manchester.
WALKER, T., Assoc. M. Inst. C.E. (*Member of Council.*)	Borough Surveyor, Croydon, Surrey.
WALLIS, T. W.	Borough Surveyor, Louth.
WALSHAW, J. W.	Borough Surveyor, Peterborough.
WARDLE, J. W., Assoc. M. Inst. C.E.	Borough Surveyor, Longton.
WATSON, J. D., Assoc. M. Inst. C.E.	Burgh Surveyor, Arbroath, N.B.
WEAVER, WM., Assoc. M. Inst. C.E.	Surveyor to the Vestry, Kensington.
WEBSTER, J. L.	Borough Surveyor, Malton.
WELBURN, W.	Borough Surveyor, Middleton near Manchester.
WESTON, GEO.	Surveyor to the Vestry, Paddington.
WHEELER, G. R. W., Assoc. M. Inst. C.E.	District Surveyor, Westminster.
WHEELER, W. H., M. Inst. C.E.	Borough Surveyor, Boston, Lincolnshire.
WHITE, W. H., M. Inst. C.E. (*Past President.*)	Engineer to the Local Board, Oxford.
WHITLOW, HENRY	Surveyor to the Local Board, Ulverston.
WILDS, W. H.	Borough Engineer, Hertford.
WILKINSON, J. P., Assoc. M. Inst. C.E.	Surveyor to the Local Board, Newton Heath, near Manchester.
WILLCOX, J. E., Assoc. M. Inst. C.E.	118, Colmore Row, Birmingham.
WILSON, GEOFFREY	Surveyor to the Local Board, Alnwick.
WILSON, J. B.	Court House, Cockermouth.
WILSON, J.	Surveyor to the Local Board, Bacup, Lancashire.
WILSON, WILLIAM	Surveyor to the District Local Board, Dalton-in-Furness.
WINDOW, A.R., Assoc. M. Inst. C.E.	Late Surveyor to the Local Board, Bishop's Stortford. 14, Fairfield Street, Prescotts Road, Liverpool.
WINSHIP, G., A. M. Inst. C.E.	Borough Surveyor, Abingdon, Berks.
WITTS, J. W.	Town Surveyor, Skelton in Cleveland.
WOLSTENHOLME, J.	Borough Surveyor, Blackpool.
WOOD, A. R.	Surveyor to the Local Board, Tunstall.
WOODBRIDGE, C. A.	Surveyor to the Local Board, Pinner.
WORSWICK, R. A.	Surveyor to the Local Board, Saltburn-by-the-Sea.
WORTH, J. E., Assoc. M. Inst. C.E.	Borough Engineer, Burslem.
WRIGHT, J.	Borough Surveyor, Macclesfield, Cheshire.

GRADUATES.

BALL, GEO.	Borough Surveyor's Office, Scarborough.
COALES, H. G.	Beaconsfield Place, Southall.
FENTON, W. C.	Borough Surveyor's Office, Sheffield.
GREATOREX, A. D.	Surveyor's Office, Town Hall, Manchester.
HARLAND, A.	15, Charlotte Street, W.
NICKOLS, F. J.	Borough Surveyor's Office, Leeds.
PICKERING, J. S.	3, Dugdale Street, Nuneaton.
RICH, E. W.	Alderwich House, Hounslow.
SAUNDERS, J.	Borough Surveyor's Office, Newark.
YOUNG, W.	Town Hall, Salford.

TOWNS AND DISTRICTS REPRESENTED BY MEMBERS OF THE ASSOCIATION.

Abergavenny	Jon. Haigh.
Abingdon	G. Winship.
Abram	Geo. Heaton.
Accrington	F. S. Button.
„	E. Knowles.
Acton	C. N. Lailey.
Aldershot	W. L. Coulson.
Alnwick	G. Wilson.
Alton	J. Barlow.
Altrincham	J. Stokoe.
Alverstoke	W. H. Fry.
Arbroath	J. D. Watson.
Ashton-under-Lyne	J. T. Earnshaw.
Aspull	Geo. Heaton.
Aston Manor	W. A. Davies.
Audenshaw	J. H. Burton.
Aylesbury	G. Cannon.
Bacup	J. Wilson.
Barking	C. J. Dawson.
Barrow-in-Furness	W. H. Fox.
Barton-upon-Irwell (Rural)	C. C. Hooley.
Barton, Eccles, Winton, and Monton	T. Heywood.
Basford Union (R.S.A.)	J. Parker.
Batley	J. W. Horsfield.
Battersea	J. T. Pilditch.
Beckenham	G. B. Carlton.
Bedford	J. Lund.
Benwell	T. Dawson.
Berwick-on-Tweed	D. M. MacGregor.
Beverley	J. Beaumont.
Bingley	R. Armistead.
Birkenhead	T. C. Thorburn.
Birmingham	W. S. Till.
„	E. Pritchard.
Bishop's Stortford	R. S. Scott.
„	E. R. Window.
Blaby (Rural)	E. L. Miles.
Blackburn	J. B. McCallum.
Blackpool	J. Wolstenholme.
Blaydon-on-Tyne	M. Hawdon.
Bognor	W. L. Barret.
Bolton	W. H. Brockbank.
„	J. Proctor.
Bootle-cum-Linacre	W. N. Blair.
Boston	W. H. Wheeler.
Bournemouth	G. R. Andrews.
Bowdon	J. Newton.
Bradford	J. H. Cox.
Bray, Ireland	F. C. Comber.

Brecknock	R. Davies.
Brentford	F. W. Lacey.
Bridgewater	G. B. Laffan.
Bridlington	S. Dyer.
Brighton	P. C. Lockwood.
Bristol	F. Ashmead.
Bromley	H. S. Cregeen.
Burnley	J. E. Stafford.
Burslem	J. E. Worth.
Burton-upon-Trent	E. Clavey.
Bury	J. Cartwright.
„	J. Farrar.
Buxton	J. Hague.
Carlisle	H. U. McKie.
Carshalton	T. L. Heward.
Chelsea	G. R. Strachan.
Cheltenham	G. W. Sadler.
Cheshunt	T. Bennett.
Chester	I. M. Jones.
Chesterton	D. Bland.
Chichester	H. W. Stringfellow.
Chiswick	A. Ramsden.
Clevedon, Somerset	H. Taylor.
Cockermouth	R. S. Marsh.
Colchester	H. Goodyear.
Colne	J. Mallinson.
Compton Gifford	J. C. Inglis.
Coventry	E. J. Purnell.
Crewe	G. Eaton-Shore.
Crompton	J. Mawson.
Croydon	T. Walker.
„ (Rural)	R. M. Chart.
Dalton-in-Furness	William Wilson.
Darlaston	T. W. Debney.
Derby	Thos. Coulthurst.
Dorchester	W. Thomas.
Dorking	G. S. Mathews.
Dover	M. Curry.
Dublin	C. Harty.
Dudley	J. Gammage.
Dukinfield	W. Spinks.
Ealing	C. Jones.
Eastbourne	C. Tomes.
East Ham	W. H. Savage.
Edinburgh	J. Cooper.
Edmonton	G. E. Eachus.
Epsom	J. R. Harding.
Eston District	T. W. Stainthorpe.
Fenton	S. A. Goodall.
Finchley	G. W. Brumell.
Fleetwood	M. S. Gaulter.
Fulham	J. P. Norrington.

Gateshead-on-Tyne	J. Bower.
Glamorganshire (County)	W. Tanner.
Gloucester	R. Read.
Godmanchester	Geo. Stevens.
Goole, Yorkshire	E. C. B. Tudor.
Gorton	T. Mayor.
Grantham, Lincolnshire	S. G. Gamble.
Great Crosby	W. Hall.
Great Grimsby	J. Buchan.
„ „	J. Maughan.
Great Yarmouth	J. W. Cockrill.
Halifax	E. R. S. Escott.
Hampstead	C. H. Lowe.
Hanley	J. Lobley.
Harborne	R. Dixon.
Hartlepool	H. Mair.
Harwich	H. Ditcham.
Headington (Rural)	L. Turner.
Heckmondwike	T. Gledhill.
Hendon	S. S. Grimley.
Hereford	J. Parker.
Hertford	W. H. Wilds.
Heston and Isleworth	W. B. Bromley.
Hexham	R. Grieves.
Heywood	J. Diggle.
Hinckley	W. W. Cooper.
Hornsea	P. Gaskell.
Hornsey	T. De C. Meade.
Huntingdon	R. Hutchinson.
Hurst Brook	J. Heys.
Hyde	J. Mitchell.
Ipswich	E. Buckham.
Islington, Parish of	C. Higgins.
Jarrow	J. Petree.
Kearsley	T. Nuttall.
Kensington	W. Weaver.
Kidderminster	A. Comber.
King's Lynn	E. J. Silcock.
King's Norton (Rural)	R. Godfrey.
Kirkleatham	J. Howcroft.
Lancaster	A. Creer.
Leeds	T. Hewson.
Leek	J. Myatt.
Leicester	J. Gordon.
Lewes	A. Holt.
Leyton, E.	W. Dawson.
Lincoln	R. A. MacBrair.
Littleborough	F. H. Shuttleworth.
Liverpool	C. Dunscombe.
„	G. F. Deacon.
„	G. Biddle.

Llandudno	T. T. Marks.
Londonderry, Ireland	W. J. Robinson.
Longton	J. W. Wardle.
Loughborough	Geo. Hodson.
Louth	T. W. Wallis.
Lowestoft	G. H. Hamby.
„	R. H. Inch.
Luton, Bedfordshire	W. H. Leete.
Macclesfield	J. Wright.
Maidstone	F. J. C. May.
„ (Rural)	E. P. Hooley.
Maldon (Rural)	A. Stewart.
Malton	J. L. Webster.
Manchester	J. Allison.
„	J. Newman.
„	S. C. Trapp.
„	R. Vawser.
Matlock	J. Simpson, jun.
Melton Mowbray	E. Jeeves.
Merthyr Tydfil	S. Harpur.
Middlesbrough	E. D. Latham.
Middleton (Lancashire)	W. Welburn.
Milverton	G. F. Smith.
Mirfield	F. H. Hare.
Morpeth	T. W. Middlemiss.
Neath	D. M. Jenkins.
„ (R.S.A.)	W. E. C. Thomas.
Nelson-in-Marsden	W. Dent.
Neston	J. Morris.
Newark	Geo. Sheppard.
New Barnet	F. J. Rumble.
New Malden	T. L. Heward.
Newcastle-on-Tyne	W. G. Laws.
„	J. P. Spencer.
Newcastle-under-Lyme	J. Pattison, jun.
Newton Heath	J. P. Wilkinson.
Newton-in-Makerfield	R. Brierley.
Norden	Geo. Land.
Norwich	P. P. Marshall.
Nottingham	A. Brown.
Okehampton	H. Geen.
Oldbury	J. Stansfield-Brun.
Orrell	G. Heaton.
Over Darwen	W. Stubbs.
Oxford	W. H. White.
Paddington	Geo. Weston.
Padiham	J. Gregson.
Pemberton	Geo. Heaton.
Peterborough	J. W. Walshaw.
Pewsey	J. Bateman.
Pinner	C. A. Woodbridge.
Plymouth	G. D. Bellamy.
„	R. Hodge.
Poole	J. Elford.
Portsmouth	H. P. Boulnois.
Prescot	W. Goldsworth.
Putney	J. C. Radford.

Ramsbottom	T. Nuttall.
Ramsgate	W. C. Barley.
Rawtenstall	J. E. Swindlehurst.
Reading	A. W. Parry.
Reddish	E. Sykes.
Rhyl	Robt. Hughes.
Richmond	W. Brooke.
Rochdale	S. S. Platt.
Rochester	W. Banks.
Rotherham	G. Jennings.
Rugby	W. Stewart.
Ryde	F. Newman.
Sale	A. G. McBeath.
Saltburn-by-the-Sea	R. A. Worswich.
Sevenoaks	J. Mann.
Shaw	J. Mawson.
Sheffield	R. Davidson.
Sherborne	T. Farrell.
Shifnal	W. F. T. Molineux.
Skelton in Cleveland	J. W. Witts.
Sleaford	Jesse Clare.
Solihull (R.S.A.)	F. Smythe.
Southampton	W. B. G. Bennett.
„	J. Lemon.
Southend	F. H. Tulloch.
Southgate	C. G. Lawson.
Southport	W. Crabtree.
South Hornsey	Ed. Fry.
South Shields	M. Hall.
South Stockton	S. E. Thorrold.
Stafford	W. Blackshaw.
Stamford	Jas. Richardson.
Stockport	A. M. Fowler.
Stockton	K. P. Campbell.
Stoke-on-Trent	W. Bowen.
Stourbridge	W. Fiddian.
Stratford-on-Avon	A. T. Davis.
„ „	T. T. Allen.
Streatham	Jas. Barber.
Stretford	H. Royle.
Stroud	J. P. Lofthouse.
St. George, Bristol (R.S.A.)	Wm. Cloutman.
St. George the Martyr, Southwark	A. M. Hiscocks.
St. Mary, Islington	J. P. Barber.
St. Saviour, Southwark	G. R. Norrish.
St. Thomas, near Exeter	S. Churchward.
Sunderland	R. S. Rounthwaite.
Sussex (West) (County)	E. B. Ellice-Clark.
Swansea (Rural)	J. Thomas.
Swinton, Yorkshire	J. C. Haller.
Swinton and Pendlebury, Lancashire	A. H. Mountain.
Tamworth (R.S.A.)	H. J. Clarson.
Tewkesbury, Gloucestershire	W. H. Gray.
Tipton	S. F. Rowley.
Tiverton, Devon	Wm. Rowe.
Todmorden	A. Greenwood.
Tooting	Jas. Barber.

Torquay	Joseph Hall.
Toxteth Park	J. Price.
Tunstall	A. R. Wood.
Turton	Jas. Parkinson.
Tynemouth	C. T. Gomoszynski.
Ulverston	Hy. Whitlow.
Ventnor	J. G. Livesay.
Wakefield	R. Porter.
Walsall	A. Hardwicke.
Walsoken	J. Kerridge.
Walthamstow	G. B. Jerram.
Walton on the Hill	S. Middlebrook.
Wanstead	J. T. Bressey.
Warminster	T. Cruse.
Warrington	T. Longdin.
Waterloo, Liverpool	R. Thompson.
Watford	C. C. Lovejoy.
Wavertree	I. Dixon.
Wellingborough	E. Sharman.
West Bromwich, Staffordshire	J. T. Eayrs.
West Derby, Liverpool	E. H. Allies.
West Ham, London	L. Angell.
West Hartlepool	J. W. Brown.
Westminster	G. R. W. Wheeler.
Weymouth and Melcombe Regis	W. B. Morgan.
Whitehaven	R. Pickering.
Widnes	T. Higginson.
Willesden	O. C. Robson.
Willington Quay, Northumberland	P. W. Thomson.
Wimbledon	W. Santo Crimp.
Withington	J. Swarbrick.
Wolverhampton	R. E. W. Berrington.
Woodford	J. D. Hooper.
Worksop	J. Allsopp.
Worthing	W. Horne.
Wrexham	J. W. M. Smith.
„	A. S. Jones.
„ (Rural)	A. C. Bauch.
York	E. G. Mawbey.
„ (Rural)	W. G. Penty.

PARLIAMENTARY COMMITTEE.

E. B. Ellice-Clark (Hove), *Chairman.*

Lewis Angell (West Ham).
Chas. Jones (Ealing).
T. De C. Meade (Hornsey).
A. Parry (Reading).
O. C. Robson (Willesden).
W. H. White (Oxford).

RULES OF THE ASSOCIATION.

I.—That the Society be named the "Association of Municipal and Sanitary Engineers and Surveyors."

II.—That the objects of the Association be—

a. The promotion and interchange among its Members of that species of knowledge and practice which falls within the department of an Engineer or Surveyor engaged in the discharge of the duties imposed by the Public Health, Local Government, and other Sanitary Acts.

b. The promotion of the professional interests of the Members.

c. The general promotion of the objects of Sanitary Science.

III.—That the Association consist of Civil Engineers and Surveyors holding chief permanent appointments under the various Municipal Corporations or Sanitary Authorities within the control of the Local Government Board, or under the Metropolis Local Management Acts. Each Candidate for Membership shall be proposed by at least two Members, who from personal knowledge of such Candidate shall certify that he possesses the necessary qualification. Candidates residing outside England and Wales not known by two Members of this Association may be proposed by three Corporate Members of the Institution of Civil Engineers. Members who cease to hold their appointments are eligible for re-election by the Council, but will be disqualified from holding any office. Civil Engineers and Surveyors holding other chief permanent appointments under any Public Authority within the United Kingdom, or in the Colonies or Foreign Countries, shall be eligible for election as Members, subject to the approval of the Council. The Council shall also have power to elect such Honorary Members as they may see fit.

IV.—That the Affairs of the Association be governed by a Council, consisting of a President, Three Vice-Presidents, Twelve Members, and an Honorary Secretary, to be elected annually. The Past Presidents and the District Secretaries for the time being shall also be Members of the Council.

V.—That the Council shall nominate one name for President, three for Vice-Presidents, one for Honorary Secretary, and fifteen for Ordinary Members of Council. In addition to these each Member of the Association shall be at liberty to nominate one Member for the Council, but in the event of the last-named Nominations exceeding fifteen, the Council shall reduce them to that number, so as to leave thirty names in all from which to elect the required number of Ordinary Members of Council. Members' Nominations must be

in the hands of the Secretary on or before the 20th of April in each year. And in case the Members' Nominations should not reach fifteen, the Council shall have the power to make up the total number of Nominations to thirty. Such list of thirty Nominations shall be printed and sent to each Member of the Association not less than fourteen days previous to the Annual Meeting. Every Member shall be entitled to vote for or erase any of such Nominations or substitute other names, subject in all cases to the limits of Rule IV., and return the same within seven days from the date of issue. Such ballot papers shall be examined in London by the President, Secretaries, and two Scrutineers appointed at the previous Annual Meeting, or by any two of the aforesaid Members. Any Member canvassing for votes for the office of Member of Council shall be considered ineligible for election.

VI.—That the Association be formed into District Committees which shall include the whole of the Members. Such Committees shall meet from time to time, in convenient centres, for the discussion of matters of local and general interest connected with the Association. Each District Committee shall appoint a District Secretary, who will keep records of local proceedings, and communicate with the Council. All District Secretaries shall vacate their office at the Annual Meeting, and Members shall then be appointed to act as Local Secretaries until a District Meeting can be arranged, at which Meeting a District Secretary shall be appointed.

VII.—That a General Meeting and Conference of the Association shall be held annually in such towns, in rotation, as may afford convenient centres for assembling the Members.

VIII.—That each Member pay an entrance-fee of One Guinea, and a subscription of One Guinea per annum.

IX.—That no new Rule or alteration of any existing Rule be made unless Notice of Motion for such purpose and the proposed Resolution thereon be sent to the Secretary by the 31st March, and such Notice of Motion and Resolution shall be printed in the Agenda for the ensuing Annual Meeting.

X.—That Candidates successful in obtaining certificates of competency at any examination under the auspices of the Association, and who are not otherwise qualified as Members of the Association, shall constitute a class of graduates on payment of an annual subscription of One Guinea; and as such shall be entitled to attend the General and District Meetings and to take part in the proceedings thereof, and be entitled to a copy of the Minutes of the Proceedings, but shall not take part in the election of the Council. Graduates shall be transferred to the class of member when qualified according to Rule III. A graduate shall not be required to pay an entrance fee either on his becoming a Graduate or on his transfer as a Member.

UNIVERSITY OF
LIBRARY

ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

FOURTEENTH ANNUAL MEETING.

LEICESTER, *July* 14*th*, 15*th*, *and* 16*th*, 1887.

GENERAL BUSINESS.

THE Members assembled in the Town Hall, Leicester, where the Mayor, Mr. Alderman Hart, warmly welcomed the Association to Leicester.

Mr. J. Lobley then took the chair, and the Minutes of the Annual Meeting held in Hanley in July 1886 were read, confirmed, and signed.

The SECRETARY then read the Annual Report and Statement of Accounts for the year ending April 30th, 1887.

ANNUAL REPORT.

In presenting this the fourteenth Annual Report to the members of the Association, the Council are much pleased to record that all the statistics in the account of the proceedings of the past year show a larger increase of numbers than in any previous year, a satisfactory advance in the financial position, and evidence of the examinations now carried out by the Association being received with confidence by the public.

The following District Meetings have been held since the last General Meeting in Hanley on the 8th of July, 1886, and the two following days. At Rochester, on the 24th of September; at Walthamstow, on the 25th of September; at West Hartlepool, on the 2nd of October; at Warrington, on the 27th of November; at Portsmouth, on the 4th of June; at Kidderminster, on the 11th of June; and at Bolton, on the 2nd of July. These meetings

are very greatly appreciated by those Members who are able to attend them, and your Council feel it their duty as well as their privilege to publicly acknowledge the courteous and kindly way in which the Association has been received on all these occasions.

During the past year forty-four new Members, consisting of thirty-nine Ordinary Members and five Graduates, have joined the Association, two Members have resigned, and ten names have been written off; and the Council regret to report the deaths of Mr. William Whittington, borough surveyor of Neath, Glamorganshire, and of Mr. John Green Hall, city surveyor, Canterbury.

It is worthy of note that the extension of the Rules made at the last General Meeting to admit the Metropolitan surveyors is being appreciated, inasmuch as up to the present time more than a quarter of their number have been enrolled as members.

A similar result has also to be recorded with regard to the new Rule made at the last General Meeting, to admit certificated candidates as Graduates, as your Council are pleased to have to report that up to the present date 30 per cent. of those successfully passing the Association's examinations have joined as Graduates.

The number on the roll of the Association at the close of the year was—6 Honorary Members, 274 Ordinary Members, and 5 Graduates, making 285 in all. The Council trust the Members will make every effort to increase this total, by directing the attention of the various municipal surveyors with whom they may come in contact, to the desirability of their joining the Association.

The audited Balance Sheet which accompanies this Report shows a balance in hand on the 30th April of 298*l.* 6*s.* This, taken in connection with the statement of the assets and liabilities, marks the satisfactory position and steady progress of the Association.

The Ballot lists having been duly issued, the Scrutineers report the following gentlemen elected for the Council:—

President.—J. Gordon.

Vice-Presidents.—H. P. Boulnois, C. Dunscombe, E. B. Ellice-Clark.

Ordinary Members of Council.—A. Brown, J. Cartwright, T. Coulthurst, J. H. Cox, J. T. Eayrs, A. M. Fowler, T. Hewson, H. U. McKie, T. De C. Meade, A. W. Parry, R. Read, and T. Walker.

Honorary Treasurer.—L. Angell.

Honorary Secretary.—C. Jones.

Two examinations have been carried out during the year, the first of which was held on the 1st and 2nd of October in the St. George's Hall, Liverpool, the use of which was kindly granted by the Corporation of that city. At this examination twenty candidates presented themselves, of whom the following satisfied the examiners, and were granted certificates of competency:—Messrs. E. Sykes (Reddish), E. T. Beard (Lincoln), T. Mallinson (Selby), R. J. Thomas (Carnarvon), G. Ball (Scarborough), W. Young (Pendleton), J. S. Pickering (West Bromwich), J. A. Crowther (Leeds), V. H. Turner (Leeds), M. W. Jameson (Leeds), C. Brownridge (Leeds), and E. J. Silcock (Leeds). The examiners were Messrs. J. Lobley, Laws, Ellice-Clark, and Vawser. The second examination was carried out in London, on the 22nd and 23rd of April, at the Institution of Civil Engineers, Westminster, the use of which was kindly granted by the Council of that body. At this examination twenty-one candidates entered and nineteen presented themselves, and of these the following nine gentlemen satisfied the examiners and received their certificates:—Messrs. E. W. Rich (Hounslow), B. Verschoyle (Liverpool), F. J. Nickols (Leeds), C. Adcock (Liverpool), A. E. Nichols (Leeds), Hy. Dearden (Leeds), F. E. Cooper (Liverpool), Jas. Saunders (Newark), and T. W. Franks (West Bromwich). The examiners were Messrs. Lobley, Laws, Angell, Ellice-Clark, and Boulnois. The next examination will be held at Manchester in October next.

The Sanitary Institute of Great Britain, jointly with the Parkes Museum, having petitioned Her Majesty for the grant of a Royal Charter of Incorporation under the name of the Sanitary Institute, your Council, on behalf of the Association, petitioned against the granting of such charter, or, at all events, against including in a charter the power of granting certificates to local surveyors. Up to the time of this Report no decision has been arrived at by the Privy Council.

The Council have had under their consideration the question of extending the visits of the Association to foreign capitals; it is thought, however, that the subject should be brought before this meeting, and if it is here considered desirable to visit Paris for instance, steps will be taken by the Council to arrange a trip in the forthcoming months.

The Parliamentary Committee of the Council have held many sittings during the year, and have given their careful attention to the Sanitary Registration of Buildings Bill and the Sanitation of

Houses (Metropolis) Bill. The first of these Bills was promoted by the Sanitary Assurance Association, who, at the suggestion of this Association, called together a conference of those bodies from whom licentiates under their Bill were to be chosen. This conference, under the presidency of Sir Joseph Fayrer, took the Bill into consideration clause by clause, and in the many sittings several important alterations were effected, and amongst them the Association's name was added to the list of other licensing bodies. The second of the Bills above named was withdrawn at an early stage of its existence.

The Council have again given great attention to the question of applying for a Royal Charter; it appears, apart from the question of expense, there are at the present considerable difficulties yet to be overcome, but the Council are hopeful that at an early date they will be in a position to report further progress. It has been urged that registration under the Companies Act will meet our requirements, and the Council are still considering the advisability of registering under this Act pending future action in reference to obtaining of a Royal Charter.

The Council consider that the Association may desire to give evidence of its loyalty to the Throne on the occasion of Her Majesty's jubilee, and it is proposed therefore to send up at once a telegraphic message of congratulation to the Sovereign.

By Rule III., as it at present stands, a candidate for membership is required to obtain the signatures of two Members, who from personal knowledge of such candidate, shall certify that he possesses the necessary qualification, &c. In view of the difficulties of candidates who live outside of England getting such signatures, the Council propose the addition of the words, "Candidates residing outside England and Wales not known by two members of this Association, may be proposed by three corporate members of the Institution of Civil Engineers"; and lastly, the Council consider it desirable to propose that Rule VIII. should read, "That each Member pay an entrance fee of one guinea and a subscription of one guinea per annum."

The PRESIDENT having moved, and Mr. VAWSER having seconded a motion to that effect, the Report of the Council was adopted, and the ballot papers ordered to be destroyed.

The following telegram was sent to Her Majesty the Queen:—

"The Association of Municipal and Sanitary Engineers assembled at their Annual Meeting, now being held at

Leicester, desire to offer their congratulations to your most gracious Majesty on the completion of the 50th year of your reign, and we pray that your Majesty may long be spared to continue your happy rule over your loyal and contented subjects. J. Gordon, President."

In the course of the day the following telegram in reply was received from Her Majesty:—

"Mr. Gordon, Association of Engineers. The Queen has received with much pleasure the congratulations of the members of your Association. Ponsonby."

Mr. De Courcy Meade moved that Rule I. read, "That the Society be named the Association of Municipal Engineers."

Mr. R. Godfrey seconded the motion.

Mr. C. Jones moved, as an amendment, that the title of the Association be the Association of Municipal Engineers and Surveyors.

Mr. W. H. White seconded this amendment.

Mr. Hewson objected to the term surveyor, which might mean anything or nothing, and moved, as a further amendment, the omission of "and surveyors" from Mr. Jones' amendment.

Mr. Fowler urged there was as much ambiguity about the term engineer as that of surveyor.

Mr. De Courcy Meade offered to withdraw his motion, provided both the amendments were also abandoned.

Sir Robert Rawlinson suggested that it would be wise to do this, and to wait until it was seen what were the provisions of the new Government Bill affecting local government.

The motion and amendments, with the consent of the Meeting, were then withdrawn.

On the proposition of Mr. Vawser, seconded by Mr. Godfrey, the District Secretaries were reappointed until the next meeting of their respective districts.

Mr. C. H. Lowe, Mr. Price, Mr. J. T. Eayrs, and Mr. T. De Courcy Meade were appointed Scrutineers for the ensuing year.

Mr. R. Godfrey (King's Norton) and G. R. Strachan (Chelsea) were appointed Auditors for the ensuing year, on the motion of Mr. Parry, seconded by Mr. T. De Courcy Meade.

A vote of thanks to the retiring President, Mr. Lobley, was unanimously accorded, on the proposition of Mr. C. Jones, seconded by Mr. W. H. White.

Mr. Lobley expressed his thanks for the compliment.

The PRESIDENT ELECT then took the chair, and read his inaugural address.*

At the conclusion of the meeting Mr. VAWSER proposed, and Mr. LEMON seconded, a vote of thanks to the Mayor and Corporation of Leicester, for their kindness in granting the use of the Council Chamber for the meeting.

The MAYOR suitably acknowledged the compliment.

The thanks of the Meeting were also accorded to the readers of papers, and also to the President for his efficient and impartial conduct in the chair.

CHAS. JONES, *Hon. Sec.*
THOMAS COLE, *Secretary.*

* This Address, and the papers read at the meetings, will be found at the end of the volume.

Dr. STATEMENT OF RECEIPTS AND EXPENDITURE FOR THE YEAR ENDING APRIL 30TH, 1887. Cr.

RECEIPTS.	£	s.	d.
To Balance at Bank (May 1st, 1886)	206	4	3
„ Entrance Fees	38	17	0
„ Subscriptions	237	6	0
„ Subscriptions paid in advance	3	3	0
„ Arrears	43	1	0
„ Publishers' Sale of Proceedings	28	18	5
„ Examination Fees	115	10	0
„ Balance of Petty Cash due to Secretary	4	3	10
	£677	3	6

EXPENDITURE.	£	s.	d.
By Bradford District Meeting (Expenses)	2	15	0
„ S. O. Bailey Account (Lithograph)	4	0	0
„ Great Yarmouth District Meeting	2	12	6
„ Annual Meeting, Hanley (Expenses)	11	1	0
„ „ „ (Report)	10	0	0
„ Hartlepool District Meeting	2	5	0
„ Warrington „ „	2	2	0
„ Messrs. Clowes (Printing vol. xii.)	117	8	0
„ Messrs. Cook and Hammond (Sundry Printing)—			
1st Account £16 15 6			
2nd „ 5 19 6	22	15	0
„ Messrs. Irvine & Co. (Account for Addressing, &c.)	5	15	5
„ Examination Expenses, London, April, 1886	22	6	9
„ „ „ Liverpool, October, 1886	21	2	3
„ Messrs. MacClure (Plate and Printing Certificate)	10	0	0
„ Printing at Liverpool	4	4	0
„ Secretary's Salary	79	4	0
„ Gratuity to Secretary	20	0	0
„ Petty Cash—Stationery and Sundries	20	10	7
Postages, vol. xii.	4	10	4
„ General	11	1	11
„ Circulars	5	3	0
„ Bank Charges	0	0	9
„ Balance at Bank, May 1st, 1887	298	6	0
	£677	3	6

STATEMENT OF ASSETS AND LIABILITIES, APRIL 30TH, 1887.

LIABILITIES.	£	s.	d.
To Estimated Liability on vol. xiii.	30	0	0
„ Sundry Printing	20	0	0
„ Secretary Balance of Petty Cash	4	3	10
„ Outstanding Accounts	0	0	0
„ Examiners' Expenses Estimated	25	0	0
„ Balance	306	17	2
	£386	1	0

ASSETS.	£	s.	d.
By Balance at Bank	298	6	0
„ Subscriptions in Arrear £73 10 0			
„ „ less 50 per cent. bad 36 15 0	36	15	0
„ Proceedings in Stock £102 0 0			
„ „ less 50 per cent. 51 0 0	51	0	0
	£386	1	0

Examined and found correct, SIDNEY G. GAMBLE, ROBT. GODFREY, } *Auditors.*
May 25th, 1887.

LEWIS ANGELL, *Treasurer.* CHAS. JONES, *Hon. Secretary.*
THOMAS COLE, *Secretary.*

DISTRICT MEETING AT ROCHESTER.

September 24th, 1886.

Held at the Town Hall, Rochester.

Mr. J. Lobley, *President, in the Chair.*

The Mayor of Rochester, Mr. Lewes Levy, received the Members in the Council Chamber, and cordially welcomed the Association to the City.

Mr. C. Jones proposed, and Mr. W. Dawson seconded, the re-election of Mr. Robson, as Hon. Secretary for the Home Counties District. This was carried unanimously.

The following paper was then read and discussed :—

PUBLIC HEALTH ACT, 1875,—THE 150TH SECTION.—REMARKS ON ITS OPERATION, WITH SUGGESTED REMEDIES OF ITS DEFECTS.

By Wm. SPINKS, Assoc. M. Inst. C.E.,
Surveyor to the Local Board of Dukinfield, Cheshire.

Preface.

This paper was prepared at the end of last year at the request of the ex-President, and at the time the Bill to amend this section was before Parliament was almost complete, and has remained in abeyance to the present time. Mentioning the matter to several Members at the Hanley meeting and finding a general desire to have the matter discussed fully, I have re-written the latter part of it without any reference to the Bill now defunct, in the hope that such information will be obtained from the facts in the possession of Members as will enable a Bill to be drawn that will

provide for the proper protection of the rights of owners, the wants of the municipalities, and the health of communities; and by a simple plan raise an efficient machinery to supersede the cumbrous procedure under the present Act which has so often led to costly litigation, complicated in its course and bewildering in its results.

No great originality is claimed for this paper. Lumley, Glenn, Chambers, and the Reports of the Local Government Board have been laid under obligation, and the digests of cases arranged in a convenient order for reference, together with a short summary on the cases, in the hope that it will be found serviceable and handy to those who so often have need of their assistance in carrying out not the least important of the varied duties which fall to the lot of the municipal surveyor. It is now rather more than ten years since this Act came into operation, and of the 343 sections of which it consists, there is perhaps not one which is more frequently put into practice and applied by Members of this Association than the 150th. That the draughtsman who drew the Bill and the House of Commons which amended its text in committee were not immaculate nor exponents of clear expression is proved by the very large number of cases which have gone to the Courts, and by the debate which took place in the House of Commons on 10th March on the second reading of Mr. Dodd's Bill to amend this and the 152nd and 153rd sections. It has, therefore, occurred to the writer that if the operations of this section were brought before you and a discussion taken upon it, much valuable information might be obtained that would serve as a guide to each of us in its working, and for this purpose I have prepared the following observations.

The course of procedure adopted by the writer in all cases is to report to his Board the condition of a private street, and to obtain from them a resolution calling upon him to prepare plans, sections, notices, and estimates of the works he proposes to execute. Upon the plan the houses are all numbered, and the full names and addresses of the owners given, the various widths, &c., are figured on distinctly, the lines of sewers and cross drains strongly marked, and also the positions of the manholes and gullies. The longitudinal section is plotted with reference to Ordnance datum, and shows the size, depth, and rate of inclination of sewer, and the intended level of the street and its relation to existing floor levels. The transverse section is plotted on a large scale, showing the

details of the formation, with the sizes and depths of the various materials clearly given, together with the rates of crossfall both of the carriage-way and footway. This, he considers, sufficiently clear and distinct for any owner to work to, should he elect to carry out the work himself as he has power to do. The notice is then drawn. For minor streets which are not thoroughfares or only residential streets and not main arteries of traffic, a local sett is used in paving; the foundation is of macadam on rock pitching. In streets of the first class, granite paving is laid and all joints are asphalted. Having thus prepared the plans, sections, notices and estimates, he lays them before the Board for approval, who sign them and order the notices to be served, and during the expiration of the stated time the documents lie in his office for inspection by the parties interested. Failing the carrying out of the work by the owners, the matter is again brought before the Board, who direct application to be made to the Local Government Board for sanction to borrow the amounts stated in the estimates. After the public inquiry has been held and the formal sanctions received, a resolution is passed to advertise for tenders, and a contract is entered into in the usual way. Prior to the contractor entering the street, a notice is sent to the owners calling upon them to remove all old materials. Upon completion of the works they are measured up and the total cost arrived at, to which is added 5 per cent. for superintending and expenses out of pocket, and this sum is apportioned amongst the owners according to frontage. Before laying the apportionment for approval, a preliminary statement of the sums arrived at as the portion of each owner is sent out, with a request that they will call and examine the apportionment and point out mistakes, if any there be. This is found to be an admirable plan, saving so much annoyance in submitting a revised apportionment. The success of this system is proved by the fact that of the seventy apportionments made during the past two years, not one has been revised, and only one has been objected to under the 257th section, the reason given being that the work was too good. No apportionment is laid for approval until every doubt is removed as to its accuracy, and then it is signed and ordered to be sent out to each of the owners, and the money to be recovered in the usual way either summarily or by instalments spread over a term of years, as the case may be.

Having made a careful study of and inquiry into all the cases which have arisen from the operation of this section and the other

sections correlative to it, the digests of which are appended hereto arranged in direct order, i. e. commencing with the first line of the section and proceeding to the end, the writer begs to offer a few remarks explanatory of the meanings of terms and words as settled by the Courts, and also directions as to the procedure to be observed, and for that purpose will give them under the following heads:—

1. Street.
2. Repairable by inhabitants at large.
3. Notice to Owners.
4. Owner.
5. Premises.
6. Partial Works.
7. Sewer.
8. Service of Notice.
9. Deposit of Plans.
10. Default of Owner.
11. Apportionment.
12. Recovery of Expenses.
13. Disputes.

Street.

A "street" defined by section 4 of the Act is "any road, lane, footway, square, court, alley, or passage, whether a thoroughfare or not," but it does not necessarily follow that it is a street within the ordinary acceptance of the term, which is a thoroughfare with houses on each side, the primâ facie meaning of the word is simply confined to the roadway and footway. A bridge over a canal or railway is also a street, and a cul-de-sac may be a street. The surveyor having satisfied himself that the road he proposes to deal with is a street, must then inquire as to its dedication. A road may have been used by the public as a thoroughfare; but if there has been no express dedication by the owner, this user does not constitute it a street, and the fact of its being laid out is not a dedication. A surveyor cannot of course ascertain what covenants are stipulated upon in leases as to the laying out of streets, but he should take all reasonable precaution to ascertain that the road has been dedicated. Unless a street is declared to be a "highway" under section 152, the provisions of this section may be put in force as often as occasion requires.

REPAIRABLE BY THE INHABITANTS AT LARGE.

These words are used in contradistinction to "repairable by individuals ratione tenuræ." The cases that have been decided under this head have been applicable to roads where tolls have been charged by the owners. In the case of Taylor v. Oldham, the Master of the Rolls (Jessel) delivered a very interesting judgment as to the operation of the Act upon courts and alleys.

NOTICE.

Particular care is to be exercised in drawing the notice and describing the work required to be done; and if words are added in excess of what is prescribed, it has been decided that the notice is bad; but a notice which is ultra vires as to part but good as to the residue can be enforced in respect of that which is valid. In cases where some owners do the works and one or more are in default, it is not necessary to serve them with a fresh notice before doing the work. With regard to the service of notices, they may be given to the owner or occupier, but the owners only are responsible for the expenses if recovered summarily; and service is held to be good if delivered to the person who is de facto in receipt of the rent, and service at the owner's place of business by delivering and reading to his clerk is a good service. No provision is made in the Act for an objection to notice. Whatever objections an owner may have cannot be raised until section 257 comes into operation.

OWNER.

The word owner includes any person receiving the rent of the property in respect of which that word is used from the occupier of such property on his own account or as trustee or agent for any other person, or who would receive the same if such property were let to a tenant.

PREMISES.

This word by section 4 means "messuages—buildings, lands, easements, and hereditaments of any tenure." Under this definition many important and interesting cases have been decided which are a useful guide to a surveyor. A railway or canal running

parallel to and adjoining a street are liable, as also a railway crossing over a street; but where a road was carried over the railway it was decided that neither the railway underneath nor the slopes of the cutting could be said to abut on to the road nor even the parapet of the bridge. There are many cases of premises, such as school-yards and courts, only having access to a street by means of a passage; in these it has been decided that the benefit of access to the street was the foundation for the liability; but an opinion has been expressed that where the passage is common the liability would not attach. From the cases of canals and railways before mentioned, it will be seen that they may have no direct or consequential benefit from the street, and the owner of a wall at the end of a cul-de-sac is similarly situated; but directly the street is declared a highway under section 152, they may break openings upon it and enjoy the full rights of light and way. Bridges over a stream it appears are premises abutting on to a street. In one case where a man held a strip of land 4 inches wide on which was the fence of the street, he was held to be the owner of premises abutting on to the street; and in another case, where a party was sued whose land was divided from the street by a wall which did not belong to him, he was held not to abut on to the street. It has also been held that the soil of private streets abutting on a new street was land abutting on such street,—but not the soil of public streets. These decisions were under the Metropolis Managements Acts; but it has yet to be decided under this Act how the apportionment is to be made for the intersection of cross streets.

Partial Works.

It appears that separate works can be carried out, but they must be apportioned upon the whole of the owners, it being invalid if divided up into sections, according to a ruling under the Metropolis Managements Acts, but in a case decided under this Act, it was held that the apportionment on the particular owners affected was right.

Sewers.

The Act does not define how the sewer is to be designed and calculated, but probably the principle of the Fulham v. Godwin case would apply to a sewer laid in a street under this section, i. e.

that the street must be regarded as isolated, and the sufficiency of a sewer determined with respect to the street itself and not to the requirements of the neighbourhood.

Levels.

Under 11 and 12 Vict., c. 63, s. 69, a Local Board had power only to require a street to be levelled with reference to any want of equality or want of uniformity in the street itself. They had no power to require the level of a street to be raised or lowered so as to bring it into uniformity with the adjacent streets. The late Lord Chief Justice Cockburn said:—"Under the words of the 69th section the Board has no power to require the appellant to raise the footpath to the level of the adjoining streets. The object was to make each street uniform, and it must be looked at as one isolated street so far as this question is concerned. If there are inequalities in it, there is power to make it level. It may be that it would be a convenience for the neighbourhood if this street was made of the same level as those near it, but there is no power to throw the expenses of doing so upon the owners."

Deposit of Plans.

It is necessary that these should be on view at all reasonable times while the notices run; but as the provision is directory only, and not a condition precedent to the recovery of expenses, any lax compliance with it will not prejudice the action in recovering the expenses.

Procedure on Default of Owners.

It must be noticed that the Urban Authority have a discretion as to whether they will execute the works or not; but they are not permitted arbitrarily to interfere, and must afford the owner all reasonable opportunity of doing it himself; but if they choose they can arrange with owners to waive the notice and do the work by agreement. In many cases owners often endorse an order on the back of the notices; but it must be borne in mind that this submission does not relieve them from any responsibility as to any wrongful procedure or position on their part. Before proceeding

to make a contract, the surveyor should ascertain that all the preliminaries have been rightly observed. Large sums of money have been lost owing to notices having been invalid, and the Authority are presumed to be in a position to find the money even if they fail in collecting it from the right parties. It is not necessary, however, for the surveyor, before making a contract, to submit an estimate as to future repairs, nor does the omission in any way prejudice the right to recover the amounts apportioned on the several owners.

Apportionment.

This is the last duty almost that the surveyor is called upon to perform, and he must take care that the charges on his form are for the particular works described in the notices served, i. e. that each street is treated as a street *per se;* it will not do to lump the costs of a block of streets together, and apportion them amongst the owners of all. An apportionment if requiring to be corrected should be laid again, but a correction by the surveyor after approval by the Authority does not invalidate it. In one case an apportionment had been signed by a surveyor who had ceased to hold office, and it was a nullity, and so treated.

It is usual to add to the total sum expended on the works a charge for superintendence and incidental works. There does not, however, appear to be any authority for this in the Act; but a Metropolitan District Board of Works were allowed to recover the costs of obtaining names, advertising and collecting, &c. A charge is also generally made for interest from demand; this also is not very decided as to who is to settle the amount.

By the time the apportionment is made, very likely blocks of property may have changed hands, and the surveyor must bear in mind that the expenses are a charge upon the premises, and that the party upon whom the notice was served cannot be made to pay if he has ceased to own the property. The direction of the late Lord Chief Justice Cockburn, in the case of Reg. v. Swindon Local Board, is very clear upon this point. There is no limitation of time during which to remain effective, and successive owners are liable, until the charges are reimbursed with interest. Yet the owner is personally liable in so far that summary proceedings may be taken against him.

Recovery of Expenses.

This part of the section hardly comes under the surveyor's direction, and more properly is a duty to be performed by the legal adviser to the Authority. For the several methods of enforcing payment of the expenses incurred, see the cases quoted in the Appendix, but more especially the clear and lucid judgment of Mr. Justice Brett, in Tottenham Local Board v. Rowell. The action of section 257 comes in here, and by that it is stated that the owner has a right to appeal and dispute the apportionment for three months after its receipt, and if on the expiration of that time no complaint is made in writing, then the apportionment is binding, and a demand can be made and the money recovered. The ordinary method is to proceed (within six months from the time when the matter of complaint arises) before two justices, who are to decide only upon questions of fact, such as to whether the road is a street, or repairable by the inhabitants at large, as to the liability of the person sued, &c. &c.; but they have no power to deal with or amend the figures, such being the duty of the Authority and of them only; nor have the justices any power of committal in default of distress, as the charge is on the premises, and if they are worthless, then the loss is to the Authority.

Under section 213 the Authority may recover the expenses by levying a rate upon the property in addition to all the other rates, and recover the same from the occupier, and in case the property is unoccupied, then from the owner. In the first instance the Authority must decide which course they will adopt, and it appears that the levying of a rate on the property is not a system to be commended, for the Local Government Board, in a case at Goole, cancelled a decision of the Authority so ordering, and settled that the expenses should be recovered in a summary manner.

Instalments.

In some districts the expenses are not recovered summarily, but sanction is obtained from the Local Government Board to borrow the money required, and spread the repayment over a number of years allowed by them, interest being charged not exceeding 5 per cent. This is an alternative permission to section 213. Of late years there has been a tendency to reduce the period of repayment

very considerably, five years being the outside limit; whereas formerly loans have been sanctioned for thirty years, which is absurd, as no work can be guaranteed for that length of time, and if it is necessary to renew the work before the expiration and the road should have become a highway, the Local Government Board will refuse sanction to a second loan unless the first one is paid off. Therefore the works will have to be paid for out of revenue, or else abandoned altogether.

Arbitration.

If the Authority and the owner agree, the matter can be referred to arbitration under the provisions of the 179th section; but the only question to be considered is the amount to be borne by the defendant owner, and not the question as to expenses being reasonable or properly incurred by the Authority. If an arbitration is held which concerns the whole of the disputing frontagers in a street, the consent of each one to the reference must be obtained, because each has the power to appoint a separate arbitrator, and an award is not binding upon a frontager not a party to the arbitration.

Appeal to the Local Government Board.

By section 268 it is provided that if a frontager feels himself aggrieved by a decision of the Authority with respect to an apportionment, an owner may address an appeal to the Local Government Board, asking them to interfere and inquire into the whole matter, which they have power to do, and their decision is final and binding on all parties. An appeal cannot be made upon receiving notice to do the works, nor on receipt of notice of apportionment, but only after having received a demand from the Authority which may be taken to be their final decision.

Advantage is often taken of this power of appeal, and the Local Government Board have interfered in several cases, but sometimes owing to informalities on the part of the appellants they have had no power to adjudicate.

The writer has recently been engaged in a case where it was decided to question the particulars of an apportionment by appeal

to the Local Government Board. All the proper procedure was duly observed and much correspondence took place, but no formal demand had been made for the money. A notice to arbitrate was served by the Authority; and thereupon the owner, taking this as their final decision, addressed a memorial to the Local Government Board, but they decided it was not a decision at which an owner could feel aggrieved, and they declined to intervene. The next step of the Authority was at a meeting of its Finance Committee, when it was decided to summon the owner in the county court: the day after this meeting a letter to this effect was sent to the owners' solicitors, but no action was taken until the committee's minutes were confirmed by the Authority, and within twenty-one days from that date a fresh memorial was addressed to the Local Government Board, who replied that it was not in time, and should have been sent within twenty-one days from the receipt of the letter giving the decision of the Finance Committee. This decision of the Local Government Board is of the utmost importance, as it has hitherto been considered that minutes of committees were not binding, nor were they decisions of an Authority until the recommendations contained in them had actually been read and confirmed.

The cases settled are given in their proper places in the Appendix. Other cases have been decided in favour of the Authority, but the details of these are not reported by the Local Government Board.

This is not necessarily the only method of appeal against a decision of an Urban Authority. A case may be stated and the appeal carried to Quarter Sessions, but the other will be found to be the more satisfactory, and is more beneficial when the ground of complaint is insufficient to obtain a legal remedy, or where such legal remedy if obtained would not satisfy the equity of the matter.

SUGGESTED REMEDIES.

It is highly probable that the Bill dropped at the end of last Session may be revived in another form, and it would be well for each of us to point out and discuss cases that have come to our knowledge, and which we may consider require providing for in any future legislation. I therefore propose to deal with the paragraphs of the section consecutively.

Street.

The term street should include a dedicated road, whether built upon or not. A road may be an important thoroughfare largely used, but in a deplorable condition, and being confined only by walls and fences, the owners cannot be reached under the present Act.

Boundaries.—In some instances roads have boundaries running down the centre or along the building line: possibly the adjoining Authority may be a rural one. The present method of dealing with these cases is by mutual agreement. The Authority proposing to do the work should have power to treat the external premises as if in their district, and to recover the expenses in the usual way.

Notices.

It will be generally admitted that the present method is unsatisfactory and unreliable, however great pains may have been taken to be precise. The Manchester method of posting in the street and advertising in the newspapers is an admirable one. The great difficulty in describing the works in the notice is to decide upon the class of materials to be used and quality of work to be executed. This is very seldom done so as to give universal satisfaction. In some towns a hard and fast line of equality is adopted throughout: in others distinctions are drawn at the instance of the surveyor or his committee, and neither plan can be said to be equitable. In most towns the character of the streets will admit of them being divided into classes as follows:—

Class 1. Streets being main arteries of traffic and means of communication between one populous locality and another; or lined with important property.

Class 2. Streets running crosswise between main arteries, and only having light and local traffic.

Also culs-de-sac.

Class 3. Courts and alleys.

Class 4. Roads amongst better class residential property, such as suburban roads.

I would propose that these roads should be dealt with in this manner:—

Class 1, to be formed of the best materials and workmanship throughout.

Class 2, to be formed of secondary materials, but not inferior workmanship, and on sanitary grounds to have an impervious pavement, as residents in this class of property almost universally throw their slops and waste out of doors on to the roadway, which certainly should not be a filter bed nor straining tank.

Class 4. Having regard to the quality of the property and the convenience and comfort of the inhabitants in this class, it might be desirable to form these roads of macadam or asphalte carriage-ways with gravelled footpaths.

If the Local Government Board were to hold an inquiry in each town and their inspector were to view the character of the streets it was proposed to classify, he, by hearing evidence as to the quality of materials the locality afforded, would be enabled to set up a standard to be used in each case, and this would go far to settle the present dissatisfaction and prevent costly and cumbrous litigation. The owners should have power to appeal to the Authority if the proposed works were considered excessive; and if no arrangement could be arrived at, then to a bench of magistrates who from local knowledge could soon decide the equity of the matter. The great object should be to arrive at a satisfactory understanding before commencing the works, and thus prevent disputes as to facts arising afterwards which ought to have been decided at the outset. There should be no difficulty in doing this.

Estimate and Preliminary Apportionment.

The estimate of the works prepared by the surveyor should also include an approximate apportionment of each owner's share. The present method is to apportion by frontage only, although it is a popular notion that each party pays for the exact amount of work from the building line to the centre of the road. To prepare separate accounts for each block would entail an enormous labour on the surveyor, and by particularising the items would enable each party to check the quantities in his own style, and would lead to interminable disputes and demands for amended accounts. Some method must be devised that will remove the present injustice of charging in streets of varying widths the owners of premises in the narrow portion a share of the cost of the works in the wider portion, and which relieves the owners in that part of a considerable amount of their proper burden.

Intersections of Cross Streets.

This question is also a very vexed one. The present plan of measuring the frontages net and apportioning the costs of the intersections over the whole area is the simplest if not apparently the most satisfactory method, and it would cost far more than the amount involved for any frontager to contest the fairness of the charge. It would certainly be very difficult where a street in a rectangular block running say east and west was paved to terminate at the west side of a street of less width running across it north and south; the streets at the end and both sides abutting on to it being unpaved, but likely to be, and to have an equal user and enjoyment of the intersecting area. The question to decide would be how far in each direction (other intersections being adjacent) will that user extend, and in what proportion are the expenses of completing it to be borne? Is there any man living who would hope to decide in a satisfactory way?

Consequential Benefits.

Collieries, workshops, and other premises using team labour are often situate a short distance from private streets and having a communication therewith by means of a cart-road which may run between two rows of dwelling-houses. In many cases these places by their traffic cause the carriage-way of what for the requirements of the property would be a fair and satisfactory street, to be cut up and rendered impassable, and bring down the Authority upon it with the powers of this Act; and when the works are completed, these destroying angels escape scot free and carry on their business at greater convenience and economy. They ought in equity to contribute to the cost of these works, and some system on the sliding scale method should be devised to regulate the apportionments in these cases without the liability being incurred of going to arbitration on each one.

Railways and Canals.

A great deal has been urged about the hardship of compelling railway and canal companies to pay according to frontage. Certainly when railways are on viaducts or down in cuttings they

cannot derive much if any use from the formation of the street; but, on the other hand, the roads may be a means of communication to their depôts, and if they can be used for carrying thereto and therefrom, and from which the companies derive their revenue, then they ought to contribute towards the cost of completing such roads, which also may very likely in many cases reduce the distances to their premises and provide them with a good and easy road; and further, if the railways and canals are upon the level, a use can possibly be made of the road at some future time by the erection of wharves, &c. Certainly where main lines not in the vicinity of any station abut on to a road on a viaduct or in cutting, it can be of no possible benefit to them, and they should not be called upon to contribute to the cost of its formation.

Sewers.

Powers should be given to an Authority to contribute if necessary towards the costs of sewers in certain cases, that is to say, if for the purposes of a sewerage scheme it is desirable to construct an intercepting or trunk sewer in a private street, then the excess cost of such a sewer over one sufficient for the requirements of the street should be borne by the Authority. The writer has recently had a case of this sort in a road running along the boundary of one portion of his district, and this course was followed. It should be made plain to the surveyor that he must only design sewers sufficient for the necessities of the street he is dealing with. The writer knows several cases where sewers have been made as large as 3 feet × 2 feet when by no possibility could more sewage arise than would be discharged by a 9-inch pipe, and the defence for this has been that it is customary in the district to build sewers large enough for a man to traverse: such reasoning is ridiculous, and for the sake of the profession should be made impossible. There is one more difficulty with regard to sewers, and that is the character and condition of old sewers: in many cases these are large but loosely constructed, sufficient perhaps to carry off the drainage, but are without manholes and ventilation, and may discharge at undesirable points and be incompatible with a drainage scheme for the district. Although the property owners may have paid to the parties who laid the sewer the costs of so doing, yet they should not be relieved of the responsibility of constructing

another at the instance of the Authority, if the surveyor as their professional referee advises from structural and other reasons against their taking it over. The position and duty of the surveyor should be clear and well defined in such cases, as these matters of scientific knowledge cannot well be decided by magistrates or any other lay court.

Levels.

Frequently in altering the levels of streets it may be necessary to alter gas or water mains. Now by the '47 Acts the only parties who have power to do this are the undertakers and the Authority, and one or other must bear the cost. The undertakers may have come upon the road when it was simply marked across a field, and laid their mains under the sod without any reference to future levels or requirements. When the Authority comes to deal with such cases, acting as it were as agent for the property owners, it is manifestly unfair that such charges as will be incurred in altering these pipes to the requisite levels should be borne by the district rate; they ought in all fairness to be part of the works, and charged accordingly.

The writer has lately had a case of a road where on one side was a high bank sloping to the road, the sides of which continually slip down. Under the Act there is nothing to control this, and it appears the parties cannot be dealt with until the road is taken over, when they could be prosecuted at common law for an obstruction. It would certainly seem to be hard upon an owner in such a case to compel him to slope his banks at a given inclination, because he might fairly say it would rob him of so much land at the top level which he might reserve if he built a retaining wall which it may not be convenient to do at the time the road is being formed. These cases may not often occur, but when they do they occasion considerable trouble—probably some provision can be framed which will deal with them fairly to all parties concerned.

Partial Works.

It would often be a great convenience to a locality if parts only of a road could be dealt with and taken over by the Authority on completion. For instance, a road may be an important one as a thoroughfare, but may be only sparsely built upon; and there may

be no pressing necessity for flagging the footways, which would be a useless expense to the owners, but the paving of the carriage-way would be a great public advantage. The writer has such a case, which is urgent; but in the present state of the law it is considered by his Authority that it would bear harshly upon the owner to deal with it according to the section.

Method of Executing Works.

Another question about which there is great difference is the procedure to be observed on executing the works. Some Authorities do so by their own men, while others let all work by contract after publicly advertising for tenders. The former is open to grave abuses, and nearly always gives dissatisfaction; whereas the latter is fair and above board, and removes ground for complaint as to the works being too costly and above market price. It would be well if this system could be made compulsory.

Apportionments.

The apportionment of the costs of the work should include all incidental works, such as searching for and examining sewers, advertising, surveying, plans and specifications, &c., and 5 per cent. for superintending and office charges. Many works are extensive and must necessarily extend over a long period of time, consequently a considerable sum is incurred in interest on the money employed by payments on account. Under the present law this money if paid must be provided out of the rates, and cannot be recovered from the owners. This should be rectified, as the owners, if doing the works themselves, would certainly have to find the money from time to time for payments, and consequently to pay interest for it.

Conclusion.

This is now the completion of my task; and I may be told that many of the views I have advocated in the latter part of the paper have already been dealt with in the defunct Bill. Some I know have, and they were inserted at my instigation and through the instrumentality of thehonourable and learned member for Ashton-

under-Lyne, Mr. Jno. Addison, Q.C., who at very great trouble went with me through the Bill first printed (dated 22 January, 1886) line by line, and to his kindness in affording me valuable suggestions and criticisms I am greatly indebted, and desire publicly to acknowledge it, for mainly by his endeavours the Bill was reprinted and re-issued to the House on 29th March, 1886, containing many of the above suggestions; but nevertheless I venture to bring them before you to elicit more information on the various cases, and in the hope of obtaining sounder views on such important points from the more matured judgments and longer experience of older and more able Members of the Association.

DISCUSSION.

Mr. ANGELL: I do not know that I have any special observations to make on the subject. In fact, I have rather an outside experience, because the difficulties of private improvement work are so great, that whenever we meet with them in West Ham, we go for an Act of Parliament to correct them. Most of the defects pointed out in the paper we have already corrected for ourselves, and although we have expended 120,000*l.* in West Ham on private improvements during the last twenty years, we have not lost a single penny. The great advantage we have is, that we make our apportionment and recover the money before we do the work. Therefore, if we are wrong in law, or if there is any technical blunder, it is corrected before we spend any money. That, I hold, is the correct mode of dealing with the matter. It is held by those who framed the new Bill that it was not a just proceeding to get the money before proceeding with the work; but considering the number of difficulties and objections clever lawyers can raise, I think it is only a proper protection. It has been our great protection at West Ham, and we have never lost a single farthing expended on private improvements during the last twenty years. Mr. Spinks remarked it is now rather more than ten years since this Act came into operation; but practically the same provision was in the original Act of 1848. There is a slight difference in the 1875 Act, as to the form of procedure and depositing plans, but the 68th section of the old Public Health Act is practically the same as the new 150th, with certain additions. There it is, a matter of forty years' standing. Reference is made to the cumbrous procedure under the 1875 Act; but after read-

ing a number of clauses in the proposed Bill, I came to the conclusion that the mode of procedure will be very much more cumbrous. All the temptations to people to dispute various things would give infinitely more trouble if it did not actually lead to the loss of money. I know from my own experience the cleverness and ingenuity of the legal advisers of persons who own large properties. We have had to deal with railway companies, and canal and gas companies, who will take a case to court after court, until the final Court of Appeal is reached. I happened to have a case decided where a railway ran for a length of two miles and a quarter alongside a roadway, and they were mulcted in a sum of 7000*l*. They fought on all points, and went through court after court, but of course we had not done the work, so that there were only the law costs. Mr. Spinks evidently took very great trouble with private improvements, by showing all the details on the plans. If this were done in districts down south, I am sure the surveyor would require a very large staff indeed, because of the numerous apportionments, if he went into all the details indicated in this paper. I happen just to catch the eye of my neighbour, Mr. Savage, and that reminds me that the boundary between us goes along the centre of a road, between West Ham and East Ham. Each has made up his side of the road, and each has laid his own sewer, so that we have two sewers running down the same road. It is a great piece of absurdity, when the boundary between two parishes runs down a road, to make two sewers, when the matter might have been arranged in some much more satisfactory way. We have power under our local Act to compel owners to adjust the levels of adjoining streets. It has always been a question whether it is legal to charge for supervising works. Some of the Local Government Board inspectors recognise it as a legal charge, and allow 5 per cent. to be added; but I doubt whether it is a charge which could be sustained at law. The author seems to have lost sight of one of the most important decisions connected with this 150th section. He speaks of a hard and fast line, adopted in some places, of making the roads in some particular way. The custom of the country was, until recently, that a road must be made up to the satisfaction of the Board. It was my practice, until quite recently, to do the work according to the nature of the road. But the celebrated case of Bidder *v.* West Ham has altered this. The late Master of the Rolls, Sir George Jessell, ruled that a road was not to be merely made up generally to the satisfaction of the

board, but that every one of the items, paving, levelling, sewering, and channelling were to be done. Therefore you cannot pass a gravelled footpath—it must be flagged; you cannot pass an ordinary channel scooped out—it must be channelled with stone; and every other detail must be carried out completely in the same way. The present state of the law is that every one of these things, and not merely the road generally, must be completed to the satisfaction of the local authority. The Master of the Rolls laid this down to prevent jobbery. Frequently roads were taken over from local speculators which were not properly made up, and the expense was afterwards thrown upon the public. The author refers to the habit of some people in the north of throwing slops and waste material out of doors. In the locality where I live there are over 120,000 of the working classes, but I have not found any such habit exists. It is unfortunate if they do these things to any great extent in the north, but they are not done here. The author refers to the prevention of disputes as to the facts in the earlier part of the proceedings. This would be altogether avoided if you decided the facts before the work is begun. The remarks respecting the intersection of streets also struck me. Really I do not know of any decision on it, but the intersection of cross streets does not "abut" on any point. The most fair thing is to spread it over the whole street, the same as is done with manholes, gullies, and lamps; but I do not think there has been any legal decision on this point. There is one difficulty which I find. There are a great number of new estates and streets laid out in the district, and of course plans are deposited, according to the requirements of the section, to be channelled, curbed, &c., but we have no power to compel them to carry these out. There is no limit of time within which the work is to be done, and perhaps they only do half the work—curb it and make the streets indifferently, and then sell the property to other people and clear out. The only way I can enforce this is by bringing the 150th section to apply. It appears to me it is a mistake not to have power to make these people who lay out estates to complete the streets at once. In the course of time the people who buy the property, and who were assured the plans had been passed by the Board, are let in for a lot of expenses. Another thing is the serving of the notices. Take a house abutting on a main street; it is quite fair the owner should be compelled to pay his share of making up that street. But a

speculator may put a street at the back, and a street at the side, and to state an extreme case, may put streets all round it. The side streets and the back street would be a positive nuisance, which he would like to prevent, but nevertheless he can be compelled to bear his share of the cost of making the streets all round. Such a case is one of very great hardship, and I have had some difficult cases of streets being made alongside of property, which the owners wished to prevent being made. But the streets were made, and although to the injury of their property, they were compelled to pay their shares of the cost. I am very glad that Mr. Spinks has read this paper, as the subject will require a great deal of attention from Members of this Association, when any Bill dealing with it is introduced in Parliament.

Mr. Godfrey: The author proposes that owners should have power to appeal to the Local Government Board in certain cases, and if no satisfaction was arrived at in this way, then they may go to the local bench of magistrates. That is a point on which I feel very strongly. We have here the chief magistrate of this city, and I hope he will not take what I may say personally. I consider a bench of magistrates, unassisted by professional advice, is not a proper tribunal to deal with a professional matter of this kind. I think the precedent of the Admiralty Courts should be followed, and that a professional assessor should be appointed to advise the magistrates in such cases. There are many points which would arise, as to the character of the materials and other matters, which would be brought forward by parties defending cases, about which the magistrates would not be so well qualified to give an opinion as a surveyor, or the local authority itself. Therefore I think an assessor should be appointed to advise the magistrates, as it would strengthen the decisions of courts of summary jurisdiction, and very greatly assist the local authority.

Mr. Eayrs: A great many of the difficulties which have arisen in connection with this 150th section, and a great deal of litigation, is caused by not knowing whether the streets are dedicated streets or not, especially in old towns. It is very difficult sometimes to get proper evidence as to whether certain streets are private streets or not. The system adopted in my town is one that I have not heard of in any other place. It is, to serve notice upon the owners to make the streets, and asking them to attend a meeting of the committee of the Corporation, to adduce evidence

if they consider the street is a public highway, or to show cause why the street should not be made. This gives owners an opportunity of appearing before the committee, and of showing whether the street is a public highway or not. This we find answers very well, and I have only had one case where it has been disputed afterwards whether the street was a public highway or not. Then as to the apportionment; when the apportionment is about to be made, to remove any difficulty as to their respective frontages, the owners are served with notice that the apportionment will be made on a certain day, and they are asked to be present in the street and point out what property belongs to them. This prevents any difficulty as to the exact length of frontage. These are arrangements which are carried out only in a few places, and perhaps they may be of interest to Members of the Association.

Mr. Ashmead: I should like to say a few words as to the way in which we carry out these things at Bristol. I agree almost entirely with what Mr. Angell has stated; but I have had no difficulty in recovering money for private improvements. In fact, we have rather made a profit out of the work done. I do not think there is any necessity for any alteration. I have gone through the proposed amendment Bill, and I think it would really give us a great deal more trouble than we have at the present time. Mr. Angell, however, has gone so fully into the matter, that it is hardly necessary for me to say anything more. I notice, however, Mr. Spinks speaks of the difficulty of a main passage. What we do at Bristol is, to take the frontage of the passage and divide it amongst the owners of all the properties that use it and have a right of way over it, and so we get the money. With regard to the materials used, our committee have decided that we ought to have the work done in the best way possible—that it should be done for futurity, and in such a way that, when the Corporation is called upon to take over the street, it should not be necessary to spend any public money upon it to put it into a satisfactory state. With regard to cross streets, I agree with Mr. Angell; I do not see how you can charge that square to any one. With regard to sewers, I have only had one case, as in Bristol all the streets which have to be made are modern; and we require plans of new streets to be sent in and the sewers to be formed and the streets to be made, before any buildings are commenced. Consequently we have nothing to do with making sewers through these streets, as they are already made. The same remark applies to the

level of the streets. We require the levels to be shown on the plan, and if they do not agree with the existing levels, we say you must either alter the old ones to the new level, or else you must adapt your level to the existing one.

Mr. SAVAGE: It appears to me there is no difficulty about the streets to be dealt with, as the Act says, "not being a highway repairable by the inhabitants at large." The street Mr. Angell has referred to as recently made up under the section has been a highway for centuries, but has never been repairable by the inhabitants at large—the case where the boundary between the two parishes passes down the centre of the road. Whatever amendments you may make in the Act, you cannot make it clearer than it is on this point at present. I quite agree with Mr. Angell that many of the suggested remedies will only throw more difficulties in the way. My experience is that, with proper care, no money is lost to the Board. I do not quite agree with Mr. Angell as to the desirability of getting the money beforehand, as I think it is rather a hardship on small owners. A poor man, who is getting his house through a building society, might have great difficulty in raising the money before the work is done; at any rate he would not experience so much difficulty in finding it afterwards.

Mr. C. JONES: There must be a great deal of interest aroused by this very admirable paper, and however much we may disagree with him on some points, Mr. Spinks has gone very thoroughly into the matter, and has given us a good deal to think about. The point of interest for us is that, as the unfortunate Bill expired last year, there is no doubt there will be another Bill introduced next session, whether we want one or not. It is therefore desirable that we should discuss this question fully, and I would suggest that it is one which might occupy the attention of our Members throughout the country, who should communicate with the Parliamentary Committee, so that we may have all the necessary information at hand when the new Bill is brought forward, and use our best endeavours to get it made a useful, workable Bill. We have trouble enough now, but goodness knows if the Bill introduced last year had passed, we should have had our work about doubled. There is evidently considerable difference between the north and the south. We do not tip this, that, and the other, out of first-floor windows, whatever they may do in the north, and I know they do do some funny things there. They have the pail system we know, and they seem to have other objectionable practices.

There is one point I feel very strongly on with Mr. Angell, and that is the collection of the money. I do not think there should be any distinction between places within the Metropolitan Local Act, and places just on the other side of the boundary. Why should there be such a distinction made that on one side of the road the money should be provided beforehand, and on the other side of the road the authority has to give three months' notice, and then have to wait for six months. It is a great anomaly that such a state of things should be allowed to exist; and, as a member of the Parliamentary Committee, this is a matter I shall do my best to get remedied. If the feeling of the House should be that this had better remain as it is, it might influence our dealing with the Bill; but I think it would be very little hardship for the whole of the money to be raised before the work is done. With respect to the term street, I should just like to make a remark. It has been referred to before, but notwithstanding the dictum of the President, I should like to allude to it again. It appears to me that a street over which there has been a right of user, is dedicated to the public, and repairable by the general public, does not remove any difficulty. I do not think any clearer clause could be inserted in any Act. One point is so extraordinary that I should have liked our friend to have given us some more details. We have all great faith in the Local Government Board, but that they should have come to the decision that the decision of a committee was that of the Board, was absurd. I never heard of such a thing before. If such a decision is correct, we do not know where we may be landed. We have always considered the action of any committee a nullity until it has been approved of by the Board. I cannot but think, with all due deference to the author, that there must have been some mistake here. That a decision of a committee, which may be a minority of the whole Board, should be binding, is certainly an absurd dictum on the part of the Local Government Board, if it is correct. Our friend has had something to do with the framing of the late Bill, and he may have something to do with the working out of the next one. He suggests that a Local Government Board inspector should view certain streets, and decide as to the character of the material to be used. I should not like that put into the Bill; and I hope such a thing will not be suggested. If there was such a provision, there is no knowledge where we should be landed. Why the country has been flooded by pamphlets put out by some worthy gentleman connected with the Cyclist Society,

respecting the size of flint stones in roads. I put mine into the waste-paper basket, and thought it the best thing to do with it. There are a lot of quotations in that pamphlet, from gentlemen who have written upon roads, and it is said Mr. So and So says so and so, and then it is sent out with the authority of the Local Government Board attached to it. This gentleman in his pamphlet has been copying from a book fifty years old, but fifty years ago there were no steam rollers. That which might be all very right to put into a book fifty years ago, may be altogether fallacious at the present time. When papers are put out, giving mere extracts, whether from Local Government Board reports or not, I say it is very great folly, and I should be very sorry that anybody who wants a road made of mud, when I want it made properly of stone, should have the right to appeal to the Local Government Board on the subject. It would lead to a vast amount of confusion and difficulty, and cause no end of mischief. I think it is far better that the road should be made as we require it. I should very much object to meet the owners in the street where the apportionment is to be made. If I had to meet 150 owners, to define the boundaries of their properties, I never could get through the work. I would very much rather take the bull by the horns, and make my own apportionment, and if they objected to it when it was done, let them go and do so. There are a great many other points that I will not go into, and I just throw out these few hurried remarks for your consideration. Our attention is naturally turned to this 150th section, because we have most to do with it; and out of the multitude of councillors we may get a Bill which will be an advantage to the nation at large, and something more generally workable than the Act we have at present, or the Bill which expired prematurely last session.

Mr. Santo Crimp: I should like to say a word with reference to the question of the intersections of lateral roads. We will assume that the notices to make up a road have been duly served upon the frontagers, and that they all comply. Upon whom devolves the duty, then, of making up the portions opposite the ends of the lateral roads? Then, again, in designing a sewer in straight lines from manhole to manhole, it is impossible, in a crooked road, to keep the sewer in the middle of the road; a frontager might therefore comply with the notice, and yet not contribute one farthing towards the cost of sewer, although he enjoys all the advantages of its construction. The same with gullies and so on, a state of

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affairs manifestly unjust. With regard to old sewers, if these are not satisfactory to the local authority, they can, under the section, require the road to be "sewered" to their satisfaction. In these cases, the old sewers may be retained for surface water if the levels admit. I notice that "kerbing" is not mentioned in the existing section.

Mr. COULTHURST: We have had considerable experience at Derby, having completed about nine miles of streets during the last seven years. With regard to the charge of 5 per cent. for interest and oversight, I should like to know whether there is any opposition to it, and whether owners pay it. About seven years ago, our highways committee decided that 10 per cent. should be charged, but this caused considerable grumbling. We got it, however, for about two years, and it was a source of considerable profit to the sanitary authority. It did not go on for long, however, as the owners, after grumbling about it, appealed to the Local Government Board. An inquiry was held by the Board, and the result was that they decided that the sanitary authority could not charge anything for preliminary work up to the service of the notices, that they must examine the street, ascertain the position of the sewers, and prepare plans and specifications at the cost of the sanitary authority. I do not know if this has been the case anywhere else. However, it has been our experience, and according to the decision of the Local Government Board, 2 per cent. is all we now charge for supervision, the clerk of the works on the ground, and interest on the outlay. Supposing it takes six months to do the work, we should only be able to charge 2 per cent. upon the amount. The owners of property are satisfied with this 2 per cent., and pay it. This bears out what Mr. Jones has remarked respecting the decision of a committee—that it is impossible for the decision of any mere committee to be binding. The committee decided that 10 per cent. should be charged, and although it was adopted by the Council, it could not be enforced.

Mr. GOODYEAR: It is the practice with us, for the surveyor to take the levels, and prepare the plans and specifications. There has never been any charge whatever on the owners for this, and the Corporation have advanced money to the contractors, for which they have had to pay commission to the Bank. The surveyor has also given his services, and the owners have not been charged for anything whatever beyond the contract.

Mr. JERRAM: Nearly all the points I had noted have been taken

up by previous speakers. I think the proper thing would be that persons who speculate in building land should be required to make the streets. I think it is unfair that speculators should come into suburban districts, set out streets and just scratch over the ground, and then sell their land to other people on whom it is a great hardship to be called upon to make the road properly afterwards. The difficulty of getting any money from those poor people, who have bought their land and houses through building societies, is enormous. I was told recently that at Nottingham they had 30,000*l.* or 40,000*l.* out in this way on poor property, and that it was most difficult to get the money repaid. I think a street should be made at the outset in a thoroughly substantial manner by the owners of property, as the ratepayers have to keep them in repair afterwards. The excuse of course is that the roads will be cut up by the builders, but they will not be any more than by heavy traffic on common roads, and under the Highway Act the builder can be required to deposit money beforehand to restore it and put it into good repair. By this means we should be saved all the trouble of this wretched 150th section, because, after all, it is really a fight between the owners and the ratepayers. At the recent Sanitary Congress at York some one was kind enough to state that 57 per cent. of the members of Local Boards are owners of property, so that it was in the interest of the ratepayers and owners of property that surveyors and Local Boards were established. Therefore we should have the work done in a substantial manner, and not lean to the owners at all. I am pleased to learn there is a Parliamentary Committee in existence to watch this question, as I had intended to propose the appointment of one. I hope suggestions will be made to the committee by gentlemen from all parts of the country, and that a general meeting of Members will be called when the committee has decided upon the matter, in order that we have another opportunity of considering the subject, when any Bill comes before the House of Commons.

Mr. Robson: There is only one point upon which I should like to have the opinion of Members, and that is relative to the making up of portions of new streets. At present there seems to be some difference of opinion, as the Local Government Board is quoted on one hand, and Law Courts on the other. In my locality, in the rural part of the district, there are many lanes only 14 or 15 feet in width. The "jerry" builder comes there, sets back his buildings, and widens the road some 12 or 14 feet. He makes a

bad road in front of the houses, professedly widens the street, and leaves it. The houses become occupied, the ratepayers soon complain, and the Board set about making this part of the road, and charge the owners with the cost. An appeal was made by owners to the Local Government Board, when it was contended the road was repairable by the inhabitants at large, and the result was that the Board was saddled with the cost of doing this work, between 500*l.* and 600*l.*, as the Local Government Board held that it was a road repairable by the inhabitants at large. I believe there are some cases decided in the courts of law, by which you may make up a portion of the road in this way, and recover their shares of the cost from the owners. With regard to percentage for supervision, &c., we charge 10 per cent. at Willesden. We have executed 38,000*l.* worth of private improvement works within the last ten or eleven years, and after calculating the cost of supervision, the clerk of the works, printing, stationery, preparing of plans and specifications, we find at the end of the eleven years that there is only a very small margin of profit left. In fact, it has cost very nearly all we have reserved from this 10 per cent. There are several other matters I should have liked to have gone into; but I will not do so now, as our time is getting short. I think our hearty thanks are due to Mr. Spinks, whose paper will be of very great assistance to the Members of the Association.

Mr. Eaton-Shore: With regard to the term "owner," I may say we only recognise as the owner the person who possesses the property on the completion of the work. We take the names of the owners, agent and occupier when we first prepare the plans and specifications, and serve notices to make upon each, and when the work is completed and a certificate to that effect is given to the contractor, we get the names of the owners again, and serve apportionment notices upon both the then owner and upon the previous owner. There is another point upon which I should like to get some information from Members of the Association. It is with regard to where a road crosses a railway, and also where a road crosses a stream. It appears, from what I have seen, that the practice somewhat differs. I have just had a case where we charged the London and North-Western Railway Company for a hundred yards of similar road; and though they would have been likely to dispute any unfair charge, they paid it without any demur. On the other hand, we have just been enlarging a bridge over a stream, and we have had to do that at our own cost, as we were given to

understand by the Local Government Board that we were not entitled to charge the owners with any portion of the cost. Then with regard to apportioning the costs, one gentleman has said we should not include incidental expenses. I may say we charge 2½ per cent. for office work, and in addition to that, we generally charge another 2 per cent. for incidentals.

Mr. W. Weaver (Kensington): The practical point under consideration is, the defects in a certain law, and the best mode of remedying these defects. A good many of the difficulties which various Members have touched upon are dealt with fully in the practical, everyday work of a surveyor under the Metropolis Management Act. If the Parliamentary Committee have to consider the amendment of the present law, it would be well for them to consider the 77th and 105th sections of the Metropolitan Local Management Acts. They would find that these give greater powers and a better mode of procedure than provided by the Public Health Act. In many points the Public Health Act is preferable to the London Act, but in this particular, I think the Metropolitan Act is a great deal superior. Under the Metropolitan Act, you can recover the money before the works are commenced, during their progress, or at any time after their completion. In my district we have done work amounting to 15,000*l.* a year, and the practice we pursue is, to make plans and an estimate, to serve notices upon the owners, and when we have got 75 per cent. of the cost, either in money or approved undertakings to pay, the work proceeds. When the work is finished, we make an apportionment of the actual cost. Sometimes there has been a considerable saving, which depends a good deal upon the state of the weather, and any balance to the credit of depositors is then returned. One of the most difficult questions we have to deal with—it does not crop up very often—is when we have been making up squares where there is a pleasure garden. The Metropolitan Act provides that the cost of works shall be charged upon the abutting owners, which it describes as the persons in receipt of the rack rental. Now in the case of pleasure gardens, there is no person receiving the rack rental, and it is not a pleasant thing to have to call upon the committee of gentlemen who have the management of the gardens to pay 400*l.* or 500*l.* In one case, the chairman of the committee had to go out, hat in hand, from house to house, and from owner to owner, as the committee were legally saddled with the charge under the Act. One or two points in the

paper struck me—if the author will forgive me for saying so—as a little inconsistent. One is that, in dealing with a sewer in a street, he advocates one system, and in making up its top surface, he advocates another. He says, in laying a sewer, you should only charge for the drainage required for that particular street, but when you come to make up the top surface you are to charge for different materials according to the difference of traffic; that is to say, if in Mr. Angell's district any one opened up a short cut to the Docks, between two main roads, you would estimate for pitching it with 9 × 3 pitching, because there would be likely to be a very heavy traffic through that particular street. That would clearly be unfair to the owners of property there, which did not require any such costly makings. I think it would be fairer to make up the streets uniformly with one description of materials, and if the traffic through any street requires an extraordinary character of materials, that it should be put on afterwards and at the cost of the rates. At page 20 the writer says:—"Some means must be devised that will remove the present injustice of charging in streets of varying widths the owners of premises in the narrow portion a share of the cost of the works in the wider portion, and which relieves the owners in that part of a considerable amount of their proper burden." Why should it be unfair to charge the cost of the work pro rata per foot run over the wide and narrow portions alike, when the abuttals throughout enjoy equal rights of user. There is one more point touched upon in the paper, the question of frontage. The Metropolis Act recites that vestries shall apportion in a just and reasonable way. That leaves scope for other methods of apportionment than frontage. Occasionally we go on the rateable value. Sometimes a street consists partly of six-storied houses and small cottages with large gardens, and there we should go upon the rateable value. In a case which I remember there was a gateway 10 feet wide entry to an omnibus yard. The omnibuses used the street eight times as much as any of the other properties; there also we took the rateable value, and the omnibus property had to pay six times more than any other abutting frontage.

The PRESIDENT: The various speakers have touched on most of the topics of which I made a note, but still I may say just a few words. This Association has a Parliamentary Committee, which in connection with the Secretary of the Municipal Corporations' Association was engaged last year with this matter, and were

instrumental in getting several clauses introduced into the Bill then before Parliament: that Parliamentary Committee was reappointed at the last annual meeting at Hanley, and will of course continue its labours, in the expectation that another Bill will be brought forward next session. A good many of the points touched upon in Mr. Spinks' paper were dealt with in last year's Bill. I do not agree with some of the Past Presidents who have spoken, that it would be well to leave this matter where it is, and not have a Bill. Although the Bill before the House last session was not all that we could wish, it nevertheless contained several useful provisions.

Mr. ANGELL: I did not say that you did not want a Bill, but that I thought the Bill introduced last year would make matters worse than they are at present.

The PRESIDENT: If we cannot get exactly what we want, we must be content with what we can get. You would be surprised at the objections taken in Parliament, and nearly everything has to be compromised to secure the necessary support to get a measure through the House. We have no chance whatever of getting embodied in a general Act the powers of the Metropolitan Local Management Act. Let us get the points we can secure now, and have the benefit of them, and in the course of a few years try to make it a perfect Act. We shall have to accept a compromise; there is no doubt about that whatever. It is wonderful how many members of the House are committed to a certain course, and some things have to be dropped and other things inserted, to secure the votes and their co-operation. I quite agree with the idea of taking some leaves out of the Metropolitan Local Management Act, and I hope we shall succeed in doing so. There are one or two points in the paper I should like to allude to. The author takes a good deal of trouble to show that an owner, if he should like to do so, has the power to carry out the work himself. I say the new Bill would be worth the having, if it only took away from the owner this power. I dare say I shall be in a minority on this point, but I have alluded to it before, and my practice is—of course I am not a lawyer—to deny that an owner has the power to do the work himself. That is the view that I have taken for the last twenty-five years. The Act distinctly says notice shall be served upon the owners, calling upon *them*. Now they have the power collectively to do the work if they choose; but has any surveyor any knowledge of more than half-a-dozen owners doing the work? Where there

were fewer than six, I have known a case where they have joined together and done the work. But during the past twenty-five years I do not remember a case where, when the owners exceeded six, they ever attempted to do the work. Has any other Member of the Association any knowledge of such a thing having been done? [A voice: Yes, I have.] That question has been asked often, but I have never heard it answered in the affirmative before. The reason I have taken the view that the owner has no legal right to do the work is, because he cannot do it. The point was raised by a speaker, a short time ago, as to what would happen if the owners abutting did the work and did not do the intersections of the streets. I said the owner has no power whatever to do the work, unless he does all the work he is told to do. He has no power to cut the street up into sections, for the owner cannot do his share of the sewer, of the manholes, gullies, or lamp-posts; and unless he can do all the work, I contend he cannot legally do any part of it. I have challenged them to raise this point, but it has never yet been raised. Combined they can do the work as a whole, but they cannot do it individually in sections. But supposing the point was disputed, the local authority can always decline to adopt the street, and it is quite sufficient to hold out this, and to say that it certainly will not be taken to if the work is done piecemeal, or in a cobbling manner. I have had a great many new streets made under this clause, and have worked the plan mentioned by Mr. Jerram for many years. On new estates I have the streets made up to a certain point before they begin to build at all, and the owners then pay to the authority the money to complete the works.

Mr. Angell: Under what power?

The President: I will come to that. Before a house can be built they must make the street, level it and channel it, and pay to the Corporation sufficient money to finish it. Mr. Angell has asked under what power? Well, we have no power, and we tell people so; but we also tell them we have got powers in this way, that if they do not do it, they will be required to complete the street, and then we shall not take it over. During the last eight or nine years there has not been a single instance of any one resisting this. In fact, they admit it is a far greater benefit to them to do this, than it would be to attempt to resist the Corporation. They make the streets in this way, and we allow them to proceed. Under the existing Act of Parliament, no house need be occupied until provided with proper sewers and drains, and this is quite

sufficient to require a street to be properly laid out and sewered. We have had some discussion to-day about the powers of the Local Government Board. We have had foreshadowed some grand scheme for county government, which will probably shortly be introduced into Parliament. I can only say this, that I hope we shall not lose the Local Government Board. I would much rather accept the decision of the Local Government Board than the decisions of a number of separate county authorities, who might rule quite differently in different parts of the country. The duplicate system has been alluded to, and I can only say that I carry it out in certain parts of the town, and require them to put down two sewers. With regard to streets abutting on a church, the authority may pay the cost out of the rates, but it certainly cannot be charged upon the rest of the owners in the street. Then, as to apportioning varying widths of streets, I quite agree with Mr. Weaver, that would not work at all. If we destroy the principle of apportionment according to the frontage of the street we shall assuredly get into a very great deal of trouble. It must be remembered that the system of apportioning the cost and expenses of streets by frontage only is a very old one—more than forty years old. It cannot now therefore be a very great hardship; and where it might be a hardship, where a new estate is being laid out, they can avoid the hardship by taking proper measures themselves to get rid of it. The question of the intersection of cross streets is a very knotty one indeed. The author asks, "Is there any one living who would hope to decide it in a satisfactory way?" I do not profess to be that man; but I have adopted the Liverpool plan, and it is satisfactory—at least I know of no instance to the contrary. It cuts the Gordian knot, though Mr. Angell might say that it is not legal. The plan is simply this; that the intersections of streets are considered as abutting on public property, and as such are charged to the rates. That plan I induced my council to adopt. I always find Councils and Local Boards willing to concede a little to owners of property in some way, and this was the point I urged my Council to concede. It has never caused any serious charge upon the rates, only to the trifling proportion of $\frac{1}{10}d.$ in the pound, and it cuts through the difficulty of deciding which it belongs to—the street you do first or the street you made last. This has been the practice in Liverpool, and for twenty-five years I have never heard of any objection to it. If the question of the legality of charging any portion of the cost

to the rates should arise, you can get over that by not paving it at all until you have adopted the street, and then you can do it. The clause relating to railways and canals we now know was the reason why the last Bill was thrown out of Parliament. I have already said it was a great pity that they were not better advised, because the Bill provides a more equitable system than the one in existence, and would enable Local Boards and Authorities to revise any hardship which might arise from charging a railway or canal abutting on a street. As to charging for preliminary works, that would be a great advantage, I admit, to have it so provided in any new Bill, and also, where streets are not built upon for great lengths, to make only the carriage-way. I will conclude now by asking for a vote of thanks to Mr. Spinks for his excellent paper. He has prepared a copious appendix (see pp. 49–82), which has entailed a great deal of trouble, and which he has handed over to-day. It is full of cases bearing upon this 150th section, and can be printed, if it is the wish of the Association. I will therefore move that the thanks of the Association be given to Mr. Spinks for his elaborate and valuable paper.

Mr. Ashmead: I beg to second that most cordially. I am sure the paper will be of great assistance to Members of the Association.

Mr. Jerram: I hope the appendix will also be printed. I am sure that it would be most valuable.

The President: It is for you to decide whether it shall be printed or not.

Mr. Godfrey: I have great pleasure in moving that the appendix prepared by Mr. Spinks be also printed, as I am sure it would be a valuable work of reference for Members of the Association. There may be one or two cases to add to it, and then it would be perfect, and would be a most useful thing for surveyors to have in their hands. Perhaps the Council will take it as a request, and have it printed.

Mr. Jerram: I will second the proposition. I think the appendix would be most valuable.

The resolution was then formally adopted, and also the vote of thanks to Mr. Spinks.

SUPPLEMENTAL REMARKS.

Mr. Spinks: I thank you very cordially for the vote of thanks for my paper; it has been a great gratification to me to have had this subject so fully discussed. I do not stand here as counsel for Mr. Dodd's Bill, nor do I even advocate it, and I quite agree with Mr. Angell and Mr. Jones in their condemnation; but when I found the Bill came out, I thought it the duty of this Association to try and make it better and to look into the subject thoroughly, and to set its teeth as it were and assert itself. In discussing the question with Members of Parliament I found that their great desire seemed to be to maintain the liberty of the subject. I think the liberty of the subject a good thing, but the convenience of the surveyor a much finer thing. Another difficulty is that Bills of this class get into the House about two o'clock in the morning, when Members want to get home, and the subject is inadequately discussed and is rushed through. With respect to the case before Judge Hughes, heard in the Ashton County Court, several solicitors were present, gentlemen of long experience, and their opinion was that the decision was a bad one. I was engaged in opposing a neighbouring Local Board, and we did not consider it worth while to try and upset the decision, nor to carry the case further.

By the word "dedication" I mean the laying out of a given piece of land to the free and uninterrupted use of the public; and I use the word in contradistinction to "adoption," which I think is the more correct word to use in the declaration of taking over by an Authority of a street after completion under this section. I am afraid I hardly made my meaning clear as to classifying the quality of streets. I did not intend that the Local Government Board should come and decide in each case, but that the Authority should, instead of adopting a hard and fast line throughout, have a discretionary power to fix the class of surface according to the requirements of the particular street; then after making public their intention to do such and such streets in a certain manner for the future, get the Local Government Board, or as has been suggested, the magistrates, assisted by a professional assessor, to confirm their decision. If the decision of the West Ham case is to be strictly followed throughout, it will affect very harshly the owners of *culs-de-sac* and other back, and what may be called quiet streets. My conviction is that some such plan as this will be

found to be inevitable, because in almost every street we should propose to do by the system suggested in the late Bill, we should be certain to have some cantankerous owner coming forward and asserting that the proposed works were unreasonable. We all of us know very well that in nine cases out of ten the owner thinks a cartload of gravel or ashes is good enough to repair a road, and anything beyond that he looks upon as downright extravagance.

While upon this matter I may say that I had not in preparing this paper forgotten the West Ham case,* but as the decision recently formed the subject of a special paper which was read and discussed by you, it seemed to me that repetition was quite unnecessary. Quite lately I observed some very strong remarks made by a Local Government Board inspector with reference to estates, laying out streets, and putting in sewers and charging them to the takers of the land, who are again called upon under the section to sewer, owing to the insufficiency, &c., of those sewers. This quite confirms what I have expressed in the paper.

The simplest and best way to settle this question of costs of sewers is no doubt to charge all sewers to the rates, just in the same way as the water mains are. Then the Authority need not feel hampered in designing sewers for private streets; nor would the question as to how far the sizes, &c., are reasonable, ever be raised.

I do not see that there is any inconsistency in my arguments as to the methods of charging for sewers and the quality of streets. No one will deny that property is considerably enhanced in value by the fact of its abutting on a street of superior finish, but the size of the sewer makes no difference to it whatever, so long as it is adequate for the necessities of the property; and further, when a man takes land for building purposes he knows very well what his liabilities are likely to be if he does so in a street of heavy traffic, and depend upon it his eyes are open to all the chances. I still hold to my opinion about charging in streets of varying width. A street may have a long length of a uniform width of fourteen yards, and a length of twelve yards wide; and it is certainly unfair that an owner of the lesser width should contribute even a small portion of the expenses of making up in the wider portion, which he has to do by the present law.

With regard to owners doing the work themselves, sufficient has

* This case will be found fully reported on p. 80.

been shown to prove that the system is a very bad one, and there are many ways in which the spirit of the present Act can be frustrated by their doing so, as witness the Wimbledon case. Beyond a doubt the fairest way to each owner is for the Authority to do the work, and for the surveyor (who is usually a man of experience in these matters) to make the apportionment.

With regard to old narrow roads being widened by builders, there does not appear to have been a ruling case on the point. In different parts of England the circumstances vary very much; in some places these old roads, although thoroughfares, have been repaired "*ratione tenuræ*," and this has always been looked upon as not removing the liability from the frontager when the road has been widened out and the section put in operation, and I know cases where the whole width from fence to fence has been apportioned among the frontagers. If the road, however, has been repaired by the Local Authority, I do not see how the land laid to it can be looked upon and treated as a separate street; and I should think the Authority, having got the land free, would show a rather "dog in the manger spirit" to refuse to make it.

It would be well in a new Act if power were given to compel the paving and flagging of back yards and passages, as it is quite as important from a sanitary point of view that these should be done as well as the front street; they are more used by the occupiers, and as a rule are more confined than the street, and it will be a great pity if this provision is omitted.

The intersections of cross streets will always be a sore point if it is left permissive as to how they shall be apportioned; and I have no doubt in my own mind that the best way out of the difficulty is to charge all work done in that square to the rates, as is done at Liverpool and Hanley. The amount in any one year would never be a serious burden to any town.

I am of opinion myself that in the recovery of the money the circumstances arising in each street must be considered separately, and that the better plan would be to demand the whole sum from each owner, and if there are individual cases of apparent hardship let them be dealt with on their merits, but in no case should the repayment of instalments extend over more than ten years. The plan of having a floating capital to work with is a good one, but the interest is rather a large sum to charge upon the rates, and if an arrangement could be made to add this to the cost of the works in each case I do not see why it could not be universally adopted,

as large sums of money are annually lost in interest on moneys advanced from the general fund to the private improvement account.

I quite agree that we may obtain many good ideas from the Metropolitan Acts, and think their system of apportionments may very well be adopted as the universal system throughout the country.

It is evident that many large towns have sufficient powers to deal with all the defects in the general law which I have pointed out, and powers which they seem to obtain without much difficulty, and it seems to me somewhat of an anomaly that the whole community should be so long without what is so much required, but I suppose that arises from the difference in procedure in Parliament. The private Bill being discussed before a small committee, and the public Bill being open to the criticism of the whole House, often gets quashed on a point which may be an exact reproduction of the power contained by many towns.

I do not suggest that Mr. Dodd's Bill is complete or will be satisfactory in its working, indeed very far from it. But what I do urge is that if that is the best the Legislature can give us, let us try of our experience to mould it to something like what we know would be a good workable Act both for the Authority and the owner. Let its direction be plain and simple, so that its operation may not be troublesome and vexatious, and the chances of litigation and disputes reduced to a minimum.

CORRESPONDENCE.

Mr. A. Goring Pritchard, Secretary to the Association of Municipal Corporations.

I have read with much interest Mr. Spinks' paper on the provisions of this section. It is a subject that has engaged the attention of the Association of Municipal Corporations for the last three or four years. The numerous defects in the present law determined the Council of my Association to prepare a Bill for dealing with the whole subject. The Bill was accordingly drawn, and afterwards carefully settled by eminent Counsel upon instructions from town clerks intimately acquainted with the working of the Act.

The Bill was first introduced in the session of 1883, again in 1884, again in 1885, and again in the session of 1886, but it was only in that session that the Bill received any adequate consideration. The Bill passed the second reading of the House of Commons without division, Mr. Chamberlain, the then President of the Local Government Board, and Mr. Arthur Balfour the past President, both speaking in favour of the measure. The discussions and divisions in committee only dealt with matters of detail.

When the Bill reached the House of Lords it met with violent opposition from the railway interest. Lord Jersey, who had charge of the Bill on behalf of the Association, succeeded in carrying the second reading; but on the railway companies obtaining in committee the insertion of a clause exempting them from contribution where their railways abutted upon but did not communicate with a street, Lord Jersey at the request of the Association withdrew the Bill. This was done on the ground that such a clause was in the opinion of the Association a gross injustice to other landowners, particularly having regard to the provisions of the Bill which required the Local Authority to take into consideration the degree of benefit derived by the owner from the proposed works.

Having thus shortly sketched the course of proceeding of the Bill, I will refer briefly to its main provisions; but before doing so, I take this opportunity of expressing the obligations I am under to Members of your Association in regard to the details of the measure. I may mention particularly Mr. E. B. Ellice-Clark, C.E., and Mr. Spinks, who subjected the Bill to an elaborate criticism; and although I was only able to adopt some of their proposed amendments, I found their practical remarks of great use in explaining and discussing the measure with Government officials and Members of Parliament.

The main provisions of the Bill are shortly these.

(1) Taking away the option given to owners to execute private street works, and conferring the original power upon the Local Authority. It is found in practice that this power is seldom if ever exercised by owners, and if exercised, the works cannot be so satisfactorily carried out.

(2) Before, however, these works can be executed by the Local Authority, notice of them is to be given to the owner, and an opportunity afforded to inspect the specifications, plans,

sections, estimate and provisional apportionment, and the majority in number or value of the owners of the premises shown on the apportionment have power to object, and their objections are to be heard and determined before any works are commenced. I am glad to notice that Mr. Spinks approves of this preliminary inquiry: under the present Act no objection is made until the works have been executed and the expense incurred, and then every possible objection both technical and otherwise is raised to the proceedings.

(3) Frontage is not to be the sole consideration in assessing the share of expense to be borne by each owner, but the Local Authority are to take into consideration the degree of benefit derived and the value of works already executed by the owner, and power is given to the Local Authority to include any premises which do not abut on the street, but which in their opinion would be benefited by the works.

The above are the leading provisions of the Bill, but it also clears up many minor points of doubt and difficulty. For example, "street" is defined to include land laid out as a street whether or not buildings have been erected on either side thereof. As the law at present stands, it is often a perplexing question whether the number of houses which have been built in a street have brought it within the decisions of the Court or not.

Another important improvement sought by the Bill is the clause dealing with incidental works, which enables the Local Authority to include works necessary or proper for bringing the street as regards sewerage level and other matters into conformity with other streets.

The Bill also contains provision for enabling the Local Authority to amend the specification, plans, sections, estimate and provisional apportionment, and greater facilities are afforded for the recovery of private improvement expenses.

A set of provisions are also contained in the Bill for dealing with the complicated questions which arise in the case of a street being partly within one district and partly within another.

The Bill as a whole forms in itself a code of procedure for the execution of private street works, and should it become law it is believed that much litigation would be prevented, and the administration of a difficult branch of the law much facilitated.

Whether my Association will reintroduce the Bill in its present

or in an amended form in the next session I cannot at present say, but trust that should they determine to reintroduce it, it will have the support of your valuable Society. I may add that as the Bill in its present shape has received after long consideration the approval of the Local Government Board, I do not think there is much chance of carrying a measure which widely differs from that Bill.

The Members then proceeded to the works of Messrs. Aveling and Porter, where they were shown the various details of road locomotives and steam road rollers in course of production. The whole of the machinery in the shops is driven by a pair of 20*-horse nominal horizontal engines made by the Firm and having* 14*-inch cylinders by* 18*-inch stroke. Passing through the foundry, where wheels and various engine details were being moulded and cast, the visitors proceeded to the erecting shop, where traction engines and steam road rollers were seen in every stage of erection. Four engines under steam were then put through their paces before the Members. The first, an* 8*-horse road locomotive mounted on spring wheels, after a few sharp runs took a fence composed of a couple of two* 3*-inch planks placed one on the other across the road, with great facility. The performance of a* 15*-ton and two* 10*-ton steam road rollers were also very much appreciated. The Members then proceeded to the residence of Mr. Thomas Aveling, where they were entertained at luncheon. After luncheon the Members were conveyed by Messrs. Aveling and Porter in carriages to the extensive works of the Burham Cement Company, but time only permitted a hurried visit to the cooperage, where cement barrels were being rapidly turned out by the aid of Messrs. Ransome's cask-making machinery. The testing room was also visited with much interest prior to the return to Rochester and London.*

THE PUBLIC HEALTH ACT, 1875,—
Sections 150, 257, and 268.

Digests of Cases bearing on these Sections classified and arranged.

INDEX TO THE CLASSIFICATION.

Appeals, 78.
Arbitration, 75.
Charge on the Premises, 68, 77.
Default of Owners, 64.
Deposit of Plans and Estimates, 63.
Disputes, 78.
Incidental Works, 68.
Levelling streets, 63.
Liability of Owner for Expenses, 72.
Notice of Demand, 77.
Notices, 57.
Partial works, 62.
Premises, 59.
Recovery of Expenses, 65.
Repairable by Inhabitants at large, 56.
Sewer, 62.
Street, 51.

INDEX TO THE CASES CODIFIED.

A.

Acton *v.* Lewsey, 68.
Ashworth *v.* Hebden Bridge, 66.
Attorney-General *v.* Wandsworth, 68.
Austerberry *v.* Oldham, 57.

B.

Baddeley *v.* Gingell, 59.
Bayley *v.* Wilkinson, 75.
Beaver *v.* Manchester, 51.
Bermondsey *v.* Ramsey, 72.
Birkenhead *v.* Sansom, 54.
Birmingham *v.* Baker, 77.
Blackburn *v.* Parkinson, 65.
Bournemouth *v.* Watts, 71.

C.

Caley *v.* Kingston-upon-Hull, 63.
Chiswick (L. G. B. Ap.), 72.
Cook *v.* Ipswich, 63, 73, 76.
Cunningham *v.* Wolverhampton, 64.

D.

Derby (L. G. B. Ap.), 72.
Dodd *v.* St. Pancras, 55.
Dryden *v.* Putney, 52, 67.

E.

Eccles *v.* Wirral, 79.

F.

Fulham *v.* Godwin, 62.

G.

Galloway *v.* London, 51.
Goole (L. G. B. Ap.), 71.
Gould *v.* Bacup, 58.
Great Eastern Ry. Co. *v.* Hackney, 59.
Greece *v.* Hunt, 66.

H.

Hall *v.* Batley, 64.
Hall *v.* Bootle, 54.
Hall *v.* Potter, 58.
Hampstead *v.* Cotton, 62.
Hartley *v.* Hudson, 77.
Healey *v.* Batley, 54.
Hesketh *v.* Atherton, 58.
Higgins *v.* Harding, 59.
Hirst *v.* Halifax, 53.

I.

Illingworth *v.* Montgomery, 52.
Islington *v.* Barrett, 56.

J.

Jacomb *v.* Dodgson, 66.
Jarrow *v.* Kennedy, 57.

L.

Leigh (L. G. B. Ap.), 72.
Lewis *v.* Cardiff, 65.
Lightbound *v.* Bebbington, 61.
Lister *v.* Hebden, 65.
L. & N. W. Ry. Co. *v.* St. Pancras, 59.
London, Brighton and South Coast Railway Co. *v.* Camberwell, 59.
London, Chatham and Dover Railway Co. *v.* London, 51.
London (School Board) *v.* Islington, 59.
Louch *v.* East London Railway Co., 51.

M.

Manchester *v.* Chapman, 60.
Marr *v.* Greenwich, 67.
Mason *v.* Bibby, 58.
Maude *v.* Baildon, 51.
Midland Ry. Co. *v.* Watton, 55, 75.
Mile End *v.* Whitechapel, 74.

N.

Nesbitt *v.* Greenwich, 76.
Newington *v.* Jacobs, 60.
Newman *v.* Baker, 51.
Newport *v.* Graham, 60.
Northbrook (Lord) *v.* Plumstead, 61.
North London Ry. Co. *v.* Islington, 52.
Northwich (L. G. B. Ap.), 72.

P.

Paddington *v.* Bramwell, 60.
Peek *v.* Waterloo, 58.
Penarth *v.* L. G. Board, 64, 78.
Plumstead *v.* British Land Co., 61.
Plumstead *v.* Ingoldby, 68, 73.
Poplar *v.* Love, 68.
Portsmouth *v.* Smith, 51, 55.

R.

Regina *v.* Fulford, 51.
„ *v.* Hutchins, 57.
„ *v.* L. G. B., 76, 78.
„ *v.* Newport, 60.
„ *v.* Swindon, 73.

S.

Shanklin *v.* Miller, 63, 74.
Simcox *v.* Handsworth, 58, 67.
Smith *v.* Croydon, 54.
St. Helens *v.* Riley, 74.
Stockport *v.* Cheetham, 56.
St. Pancras *v.* Batterbury, 65.
Sunderland *v.* Alcock, 77.
Sykes *v.* Huddersfield, 67, 74.

T.

Taylor *v.* Oldham, 51, 56.
Thomas *v.* Williams, 52.
Tottenham *v.* Rowell, 69.
Tunbridge *v.* Akroyd, 75.

W.

Wake *v.* Sheffield, 79.
Wakefield *v.* Mander, 62, 75.
Wakefield *v.* Lee, 61.
Wallington *v.* White, 53.
Wednesbury *v.* Stephenson, 67.
Westbury *v.* Meredith, 71.
West Derby *v.* Bell, 67.
West *v.* Downham, 68, 75.
Whitchurch *v.* Fulham, 62.
Widnes (L. G. B. Ap.), 72.
Willesden „ , 55, 62.
Williams *v.* Wandsworth, 61.
Wilson *v.* Bolton, 76.
Withington (L. G. B. Ap.), 63.
Woodford „ , 71.
Worthington *v.* Hulton, 64.
Worthington *v.* Sudlow, 64.
Wright *v.* Ingle, 62.

EXPLANATION OF THE ABBREVIATIONS IN THE MARGIN.

Ap. C., Appeal Cases.
B. & S., Best & Smith.
C. B. (N. S.), Common Bench, New Series.
C. D., Chancery Division.
C. P., Common Pleas.
Ex. D., Exchequer Division.
E. & B., Ellis & Blackburn.
L. J. C., Law Journal Chancery.
L. J. M. C. „ „ Magistrates' Cases.
L. T. (N. S.), Law Times, New Series.
L. T. (O. S.), Law Times, Old Series.
L. R., Law Reports.
L. J. R , Law Journal Reports.
L. J. E., „ „ Equity.
L. J. Q. B. „ „ Queen's Bench.
L. G. B. R., Local Government Board Reports.
J. P., Justice of the Peace.
Q. B. D., Queen's Bench Division.
Q. B., Queen's Bench.
W. R. Weekly Reports.

STREET.

In Section 4 a street is defined as any road, lane, footway, square, court, alley, or passage—whether a thoroughfare or not.

Lord Chelmsford said: "Street does not mean the roadway, but a thoroughfare with houses on each side." — Galloway *v.* Corporation of London. 35 L.J. Ch. 493.

On an indictment for bringing forward a house contrary to the Local Government Amendments Act, 1861, Section 28, it was held to be a question of fact for the jury whether certain houses formed a street; that in order to constitute a street, there must be a row of houses sufficiently continuous and proximate to one another, and that a set of detached houses not being in a continuous line, but some facing one way and some another, and having no appearance of uniformity, was not a street within the meaning of the section. — Reg. *v.* Fulford. 33 L. J. M. C., 122; 28 J. P., 357.

Lords Justices Page Wood and Selwyn held that the *primâ facie* meaning of the word street was confined to the roadway and footway. — London, Chatham and Dover Ry. Co. *v.* Corporation of London. 19 L. T. (N.S.), 250.

A *cul-de-sac* may be a street and public highway. — Louch *v.* East London Ry. Co., L. R. 16 Eq., 105; 42 L.J.Ch.,477.

Justices found a road to be a street, and the Court of Common Pleas refused to interfere with their decision, considering the question to be one of fact. — Newman *v.* Baker. 8 C. B. (N.S.), 200.

When a street passes over a canal by a bridge, the bridge may for some purposes be deemed a street. Per Justice Wightman. — Beaver *v.* Mayor of Manchester. 26 L. J. Q. B., 311.

The Master of the Rolls (Jessel) said: "The Act expressly calls places streets, whether they are public property or private property, or whether the public have any rights over them or have no rights over them." — Taylor *v.* Oldham Corporation. 4 Ch. D. a. p., 407.

The magistrates found as a fact that the road which had been paved was not a street in the ordinary sense, though it was within the definition in Section 4. The Court held that they were not bound by Section 4 to find that the road was a street. The definition in Section 4 merely provided that the term street should include certain places. It merely meant that if a certain place, way, or road were a street in other respects, then the term should include such place, way, or road. — Maude *v.* Baildon. L.B. 10 Q.B.D. 394; 48 L. T. (N.S.) 874.

The above case was difficult to reconcile with the earlier decisions, and was here questioned. It may be said therefore that while it is a question of fact whether a road is a street within this section it need — Portsmouth *v.* Smith. 13 Q.B.D., 184; 53 L.J.Q.B., 92;

50 L. T. (N.S.), 308; 48 J. P., 404.

not be a street within the ordinary sense if it is a street as defined by Section 4.

Also see Pound *v.* Plumstead Board of Works. L. R., 7, Q. B., 183; 41 L. J. M. C., 51; 25 L. T. (N.S.), 461; 20 W. R., 177; 36 J. P., 468.

Dryden *v.* Putney (Overseers of), 1 Ex. D., 223; 34 L. T. (N.S.), 69; 40 J. P., 263.

Dryden *v.* Putney (Overseers of). 1 Ex. D., 223; 34 L. T. (N.S.), 69; 40 J. P., 263.

A road in Putney within the metropolis ran in 1855 between an irregular line of houses and market gardens upon the south side and market gardens upon the north. Between that year and 1874 a continuous line of houses was built along the north side, and several houses lay along the south. It was held that between the two dates the road though a public highway had become a new street.

Also see Robinson *v.* Barton Local Board, 21 Ch. D., 621; 52 L. J. Ch., 5; 47 L. T. (N.S.), 286; 46 J. P., 662; Sc. in House of Lords, 8 App. Cas., 798.

North London Ry. Co. *v.* S. Mary, Islington (Vestry). 27 L. T. (N.S.), 672; 21 W. R., 226; 37 J. P., 341.

The company built a bridge over their railway with additions on which their station was erected, and they lighted the bridge with street lamps, and allowed the public for eighteen months to use the bridge as a highway. They had made an agreement with a water company to allow water-pipes to be carried over the bridge, and they now sought to close the passage of the public, so as to prevent the bridge being dealt with as a street. It was held that the bridge had become by dedication a street, and that the railway company as owners were liable to pay paving expenses.

Thomas *v.* Williams. 24 J. P., 821.

A street may be a highway by dedication to and adoption by the public. A street belonging to B. was laid out for buildings, and a street formed in 1836 which had ever since been used as a public thoroughfare. B. never formally dedicated it to the public, and in 1848 he granted a licence to W. to lay down gas-pipes, for which and for preventing others from interfering, B. had received from W. a small annual rent. Since 1853 the Local Board had repaired the street, and in 1858 they put up notices under 11 and 12 Vict., c. 63, s. 70 (corresponding to Section 152 of this Act) to make it a highway. W. having been summoned for wilfully injuring a street being a highway, it was held that there was ample evidence from which the justices might infer that the street had been dedicated to the public by B. and was now a highway.

Illingworth *v.* Montgomery. 24 J. P., 101.

A new street in the town of Bradford had been repaired by the owners in 1828, and the public had ever since been allowed freely to pass through it, and great numbers had used it. There had been no express dedication or certificate of justices rendering the township liable to repair, and it had never in fact been repaired by any one since

the above date, and it did not need repair. The Local Board having called upon the adjacent owners to pave, sewer, and level it, and on their refusal having done so themselves and obtained an order of the justices on the owner to pay the expenses, it was held that there was ample evidence that this was a highway dedicated to and adopted by the public, and the order was accordingly quashed.

Wallington *v.* White. 30 L. J. M. C., 209; 10 C. B. (N.S.), 128; 25 J. P., 358.

In 1825, by a local Act improving the town of L., commissioners were appointed who were authorised to repair all streets and highways in the town; and it was enacted that when any new streets should be laid out and put in good order to the satisfaction of the commissioners, then on the application of the owners of the soil the commissioners might declare such streets to be public highways, and were thereafter to repair such streets like the other streets in the town. In 1830 a new street was laid out and dedicated to the public, who thereafter used it as a public highway, but it was never declared to be such by the commissioners. In 1852, 11 and 12 Vict. c. 63 was applied to the town and the owners of the land adjacent to the new street were required to pave it under Section 69 (corresponding to Section 150 of this Act). It was held that this was lawful, inasmuch as the street was not a highway repairable by the inhabitants at large. The local Act having prevented its becoming a highway unless so declared by the commissioners, for the liability of the inhabitants was taken away by a provision contained in the Act giving power to the commissioners to make rates and exonerating every person assessed from the performance of statute duty for the repair of the public highways within the town. (It might have been different had the liability of the inhabitants remained as in Reg. *v.* S. George's, Hanover Square). This decision was affirmed by the Exchequer Chamber *sub nomine* Willes *v.* Wallington, 32 L. J. C. P., 86; 13 C. B. (N.S.), 865; 27 J. P., 295.

Hirst *v.* Halifax Local Board. L. R. 6 Q. B., 181; 40 L. J. M. C., 43; 25 L. T. (N.S.), 28; 19 W. R., 279; 35 J. P., 261.

The above case was afterwards cited and distinguished in this. By a local Act of 1798 trustees were authorised to pave streets in the township of H. and levy rates on the inhabitants, and all who paid these rates were to be exempt from all other charges from paving. In 1816 A. laid out a street which he dedicated to the public, and in 1819 it had been used by the public. In 1823 another local Act passed and repealed that of 1798. It appointed trustees who were to have all the rights, duties, and obligations of highway surveyors, and exonerated the inhabitants from liability to repair the highway. In 1851 the Public Health Act was applied to the township of H., and on paving the street the Board charged the expenses on the adjoining owners. It was held that the street was a highway repairable by the inhabitants at large, for there was nothing in the first local Act which prevented the street becoming a highway by dedication and user, and that the second local Act applied only to streets then in progress or afterwards laid out, and had no effect on streets already public. Mr. Justice Lush said: "Had the second Act been passed before the street became a highway, the case would have been analogous to Wallington *v.* White" (*sup.*).

Healey *v.* Batley Corporation. L. R. 19 Eq., 375; 44 L. J. Ch., 642.

An owner of land had in Jan. 1850 demised the coals under it for six years to K., the owner of the adjoining land. In the lease was an agreement that a street to be called Union Street should within five years be made across the land under which the coal lay and K.'s land; that a sewer should be made under such road; that the lessor and lessee should at their own cost construct and repair so much of the said road and sewer as should extend along their respective lands, and that the road should be used as a public road for all purposes for ever thereafter, and should be maintained by each of the parties so far as the same should extend over his land until the same should be adopted by the surveyor of highways. The road and sewer were never made, and there was no dedication of a highway to the public by notice under the Highway Act. A brickfield and afterwards a colliery were opened on K.'s land, and gaps were opened through which access was obtained to the premises for carts and foot-passengers. In 1869 posts and chains were placed across one of the openings, but after a few months the chains were removed. In 1870 K.'s land was sold and in 1871 conveyed to the plaintiff in fee, and in 1872 the Local Board called upon him to pave and sewer the alleged street. It was held that the agreement in the expired lease had been abandoned and could not be enforced, and that it did not amount to a dedication of a right of way to the public.

Hall *v.* Bootle Corporation. W. R., 862; 44 L. T. (N.S.), 873.

H. (who was lessee of land under a lease dated 1855) in 1865 laid out a proposed road across part of her land and built six houses on one side of the road. In 1870 she abandoned her intention of making the road, and in 1874 demised the remainder of the land including the site of the abandoned road. In 1880 the Urban Authority called upon the representatives of H. to pave the road; and on their neglecting to do so entered upon the land and began the work. It was held that the laying out of the proposed road was no dedication of a public right of way, and that an injunction must go against the Urban Authority.

Also see Rolls *v.* S. Mary Newington (Vestry), W. N., 1873, p. 168.

Smith *v.* Croydon Local Board. 32 J. P., 709.

S. and other owners of land laid out plots for building, with roads, and engaged a contractor to make the roads to the satisfaction of the Local Board of Croydon. The surveyor of the Local Board did in fact approve of the roads, but did not report the matter to the Board, and no formal approval by the Board was ever given; but the Board having a burial ground situated near, did in fact keep part of the roads for some time in repair, including the part adjacent to S.'s frontage. Afterwards the Board called on S. and other owners to sewer the road, and on S. failing to do so, did the work and sought to recover the expenses. It was held that the Board had never indicated their satisfaction with the paving, &c., and was not estopped from recovering the expenses.

Birkenhead Improvement Commisioners

By a Local Government Act of 1838, all streets, ways, and places fully built upon not being highways were to be paved, and all such streets, ways, or places as were then making and might be thereafter

made though not fully built upon were to be paved, and the expenses to be paid by the frontagers. S. occupied a house in a street, formed about 1853, and since used by the public. It was held that he was liable to pay the expenses of paving.

v. Sansom. 40 J. P., 406.

D. was the owner of a house, the back premises of which had a door leading into an alley or lane, which had been used for about fifty years in common by the tenants of nine houses as an access, but there was no thoroughfare through it. It was held that there was evidence justifying the magistrate in finding that this was a new street within the meaning of the Metropolis Management Acts (18 and 19 Vict., c. 102, s. 105, and 25 and 26 Vict., c. 102, s. 77), so as to make the owners of the houses abutting on it liable for the expenses of paving it.

Dodd *v.* S. Pancras Vestry. 34 J. P., 517.

In 1857 a local Act was passed which incorporated Section 53 of the Towns Improvement Clauses Act, 1847 (10 and 11 Vict., c. 34). In 1874 the appellants in their capacity as the Corporation of Portsmouth bought some land of the respondent abutting upon a county high road within the district to which the local Act applied, and in pursuance of an agreement then made with the respondents at their own expense widened and improved the road and laid out a footpath along the side, and gravelled, channelled and kerbed the footpath. In 1879 the appellants in their capacity as the Urban Authority paved and flagged the footpath, and sought to recover the expenses of so doing from the respondents as adjoining owners under the powers of Section 53. The jury found that before the paving and flagging in 1879, the road was not a street in the popular sense of the term, and that the footpath had been made good within Section 53. Held by the House of Lords affirming the decision of the Court of Appeal (13 Q. B. D., 184) that the respondents were not liable, upon the ground that the footpath had been "theretofore made good" within the meaning of Section 53, but without deciding whether the road was a street within the meaning of the section. The word "theretofore" in Section 53 refers to the period before the work is done by the commissioners, not to the period before the passing of the local Act.

Portsmouth (Mayor of) *v.* Smith. 10 App. Cas., 354; 54 L. J. Q. B., 473; 49 J. P., 676; 53 L. T. (N.S.), 394.

Appellant was owner of certain premises fronting a highway, and some years since had given up a piece of land so as to form part of the highway. The Local Board sought to recover from the appellant the cost incurred by them in forming a footpath on the land so given up. Having regard to all the circumstances, it was decided that the appellant should not be required to pay the sum demanded.

Willesden L. G. B. Report, 1884–5, p. lxxxv.

The appellants were owners of land and premises fronting, adjoining, or abutting on a private road leading through a populous part of the district in West Ham. The proprietors of the road had erected gates or bars at several places along the road, at which they demanded and had taken tolls for some 30 years from persons using the carriageway

Midland Railway Co. *v.* Watton. L. J. R. M. C. (N.S. 55), p. 99.

for vehicles, horses and cattle, out of which tolls they had executed whatever repairs had been done to the road. The tolls were not taken by virtue of any Act of Parliament, and there was no evidence of any authority to erect the gates or to take the moneys, or of there being any obligation on the part of the Association to repair :—Held that the road in question even if it were a private road was a "street" within Section 4 of the Public Health Act, 1875. Held also (per Mathew, J., and Smith, J.) that the road in question was not a turnpike road.

Repairable by the Inhabitants at large.

Mayor of Stockport *v.* Cheetham.
24 J. P., 196.

The word "street" in a local Act was held only to extend to highways repairable by the public. The words were not in the corresponding section of the Public Health Act, 1848 (11 and 12 Vict., c. 63, s. 69), but were added by 15 and 16 Vict., c. 42, s. 13.

S. Mary, Islington (Vestry of) *v.* Barrett.
L. R. 9 Q. B., 278;
49 L. J. M. C., 85;
30 L. T. (N.S.), 11;
22 W. R., 402;
38 J. P., 198.

Mr. Justice Quain here said that the section applied to all present and future streets except when they are repairable by the inhabitants at large, and whether they have been dedicated to the public or not.

Taylor *v.* Oldham Corporation.
4 Ch. D., 395;
46 L. J. Ch., 105;
3 L. T. (N.S.), 696;
25 W. R., 178.

In this case the Master of the Rolls (Jessel) said "that the word street as here used clearly extends to places which are in all respects private and over which the public have no right," and he added, what is the Act for? It is a Public Health Act. The owners of these private courts and alleys are of all the people in the world the most averse to laying out money on sanitary works. It is in those places that the poor live, the very people who suffer most from the want of drainage which is so requisite for public health. It is not to be imagined that the Legislature intended to except such places from the operation of the Act. I should say if the Act were passed for anybody, it must have been to include those owners who, for the sake of gain and acquiring high rents in proportion to the annual value of the wretched tenements they allow the poor to occupy, neglect ordinary and necessary sanitary precautions. If I were to interpret it by what I might think the intention of the Legislature to be, I should suppose that the first people to be included would be the owners of these crowded courts and alleys over which the public have no street rights whatever, but which are intended to be used for the dwellings of the poor, and are unprovided with what according to modern science is known to be absolutely necessary for their well-being.

An application to justices by a Local Board for the recovery of expenses from an owner was dismissed on the ground that the street was a highway repairable by the inhabitants at large. The Local Board some years afterwards made an application against the person for the recovery of a proportion of the paving expenses subsequently incurred on request in the same street, and a stipendiary magistrate made an order for payment. It was held by the Court of Appeal reversing the decision of the Queen's Bench Division that the adjudication of the justices that the street was a highway repairable by the inhabitants at large on the first application was beyond the jurisdiction of such justices who had only power to make or refuse an order for the payment of expenses claimed, and that therefore such adjudication did not estop the Local Board from claiming the expenses they claimed on the second application, and consequently that the magistrate might make the order which he made for their payment.

Reg. *v.* Hutchins 6 Q. B. D., 300; 50 L. J. M. C., 35; 44 L. T. (N.S.), 364; 45 J. P., 504; 29 W. R., 724.

A. by deed conveyed for value to trustees in fee a piece of land as part of the site of a road intended to be made and maintained by the trustees under the provisions of a contemporaneous trust deed (being a deed of settlement for the benefit of a joint-stock company established to raise the necessary capital for making the road), and in the conveyance the trustees, their heirs and assigns would make the road and at all times keep it in repair, and allow the use of it by the public subject to tolls. The piece of land as conveyed was bounded on both sides by other lands belonging to A. The trustees duly made the road, which afforded the necessary access to A.'s adjoining lands. A. afterwards sold his adjoining lands to the plaintiff, and the trustees sold the roads to the defendants, both parties taking with notice of the covenant to repair. Held (affirming the decision of the Vice-Chancellor of the Duchy of Lancaster) that the plaintiff could not enforce the covenant against the defendants. The promoters of an intended road by deed declared that the road should not only be enjoyed by them for their individual purposes, but "should be open to the use of the public at large for all manner of purposes in all respects as a common turnpike road," but subject to the payment of tolls by the persons using it. Held that this was not a dedication of the road to the use of the public, and that the road was not a highway repairable by the inhabitants at large under this section.

Semble, a road cannot be dedicated to the public by an individual without the authority of an Act of Parliament, if he reserves the right to receive tolls for the use of the road.

Austerberry *v.* Oldham Corporation. 29 Ch. D., 750; 33 W. R., 807; 49 J. P., 532; 53 L. T. (N.S.), 543, affirmed in Court of Appeal; 55 L. J. R. Ch. D., 633.

NOTICES.

The notice may be given to the owner or occupier, but the owners only are responsible for the expenses if recovered summarily. Unless notice has been given to the owner or occupier to do the work, the expenses cannot be recovered from the former.

Jarrow Local Board *v.* Kennedy. L.R. 6 Q.B. 128; 19 W. R., 275; 35 J. P., 248.

Peek *v* Waterloo Local Board.
33 L.J.M.C., 11;
9 Jur. (N. S.), 1344;
2 H. & C., 709;
12 W. R., 252;
9 L. T. (N.S.), 338;
27 J. P., 807.

The service of notice on a person who is *de facto* in receipt of the rent, is a service on the owner sufficient to satisfy the requirements of the section.

Mason *v.* Bibby.
33 L. J. M. C., 105;
2 H. & C., 881;
10 Jur. (N.S.), 519;
12 W. R., 382;
9 L. T. (N.S.), 692;
28 J. P., 121.

Section 257, which contains provisions as to service of notices, and was not meant to prevent a notice otherwise perfectly good from being good. Therefore it was held that service at the owner's place of business, by delivering and reading it to his clerk, was a good service.

Gould *v.* Bacup Local Board.
50 L. J. M. C., 44;
44 L. T. (N.S.), 103;
29 W. R., 471;
45 J. P., 325.

The Urban Authority gave notice in the form given in Schedule 4, Form G, but added to the notice words not in the form, to the effect that if the owner neglected to do the work, they would do it and declare the expenses of such work to be private improvement expenses. It was held that they were estopped by the terms of their notice from taking summary proceedings for the recovery of these expenses, and that the notice was bad, not being an absolute notice to do the work as the section requires.

Hall *v.* Potter.
39 L. J. M. C. 1;
21 L. T. (N.S.), 454;
34 J. P., 515.

A notice which is *ultra vires* as to part but good as to the residue, can be enforced in respect of that which is valid. Thus a notice to flag a street fronting premises referring to a place which included a garden not dedicated to the public, was held to be valid so far as it applied to the street, and enforceable accordingly.

Simcox *v.* Handsworth Local Board.
8 Q. B. D., 39;
51 L. J. Q. B., 168;
30 W. R., 273;
46 J. P., 260.

Notice was given to the appellant and five others, requiring them to sewer, pave, &c., the parts of the street in front of their premises within a specified time. Five of the owners executed the works, but the appellant made default. The Board thereupon did the work, and the surveyor having made an apportionment, gave her notice accordingly. It was held that the respondents were not bound before executing the works to give the appellant a fresh notice specifying the particular works remaining to be done by her.

Hesketh *v.* Atherton Local Board.
L. R. 9 Q. B., 4;
43 L. J. M. C., 37;
29 L. T. (N.S.), 530;
38 J. P., 149.

The Local Board had duly procceded under the Act, and had sewered, &c., a new street, and no notice had been given by an owner that he disputed the apportionment; it was held that it was still open to the owner to dispute his liability, and to show that the street was a highway repairable by the inhabitants at large.

See also *Ex parte* Wake, Reg. *v.* Recorder of Sheffield, 1 Q. B. D., 291; 53 L. J. M. C., 1; 32 W. R., 82; 47 J. P., 504.

Premises.

A railway company in a metropolitan district was carried across a new street by an arch. On one side of the street the railway was carried forward on arches, and on that side was a strip of land 10 feet wide left open for the purpose of repairing the arches: this abutted 10 feet on the street. On the other side the railway was carried forward on an embankment, the sloping part of which abutted on the street about 30 feet, and at the foot was an open space also about 30 feet wide, also abutting on the street and left for the purpose of allowing slips on the embankment. It was held that the railway company were liable to contribute to the expenses of paving the street as owners of land abutting on the street.

Higgins *v.* Harding. L. R. 8 Q. B. 7; 42 L. J. M. C., 31; 27 L. T. (N.S.), 483; 21 W. R., 191; 37 J. P., 677.

A line of railway was situate in a deep cutting at a place where a road passed over the line. The road was carried over on a bridge from one boundary of the line to the other, but supported on stone piers erected on the slope of the cutting. It was held that neither the railway under the bridge nor the sloping sides of the cutting could be said to abut on the road.

London, Brighton and South Coast Railway Co. *v.* S. Giles', Camberwell. 4 Ex. D., 239; 48 L. J. M. C., 186; 41 L. T (N.S.), 162.

The railway ran in a cutting and adjoined a new street which the vestry were about to pave, and was separated from it by a wall through which there was no communication between the street and the railway. It was held that the railway bounded or abutted on the street within the meaning of the Act.

L. & N. W. Ry. Co. *v.* S. Pancras Vestry. 17 L. T. (N.S.), 654.

All these cases as to railway cuttings were discussed and approved of by the House of Lords. (See following case.)

The railway company carried a road over a deep cutting by means of a bridge. The road having been paved by the Board of Works for the district and so constituted a new street, the railway company were required to contribute to the cost of paving, &c. It was held that neither the parapets of the bridge nor the adjacent soil in the cutting were lands bounding or abutting on the new street.

This decision reversed, 9 Q. B. D., 412; 51 L. J. M. C., 57; 46 L. T. (N.S.), 679; 30 W. R., 765; 46 J. P., 532.

Great Eastern Railway Co. *v.* Hackney District Board of Works. 31 W. R., 769; 8 App. Cas., 687; 52 L. J. M. C., 105; 49 L. T. (N.S.), 509.

A local Act empowered commissioners to pave streets and to recover expenses by rates from the occupiers of houses, &c., "situated or being within any of the streets" in the district. It was held that houses and buildings in a yard communicating with a street by a covered gateway, which houses and buildings abutted on houses in the street, were situated within the street so as to be liable to the rates.

Baddeley *v.* Gingell. 1 Ex., 319; 11 J. P., 838.

The London School Board were assessed in respect of a school house which did not immediately front the street but stood back from it some 70 or 80 feet, in a large yard, the whole area being about 29,500

School Board for London *v.* S. Mary, Isling-

ton (Vestry of). 1 Q. B. D., 65; 45 L. J. M. C., 1; 33 L. T. (N.S.), 504; 24 W. R., 137; 40 J. P., 310.

square feet. There was a row of eleven small houses with gardens at the back of them between the area and this street, but the only access to the school was by a private passage which ran along one side of the last house and garden into the school yard, with gates opening from the street in question, the width of the passage being 20 feet and the length about 64 feet. It was held that the school house, though not actually one of the houses forming the street, yet practically formed part of it, so as to render the Board liable as owners for the paving expenses. The Court held it was the benefit of access to the street which was the foundation for the liability.

S. Mary, Newington (Vestry of) *v.* Jacobs. L. R. 7 Q.B., 47; 41 L.J.M.C. 72; 25 L. T. (N.S.), 793; 20 W. R., 144; 36 J. P., 583.

Establishes that the owner of land adjoining a highway or street has the right of access to it at any part where it adjoins his premises. This principle will explain many of the cases where there was no direct access to the street. And it is not necessary apparently that there should be actually if there is a possibility of access.

Reg. *v.* Newport Local Board. 32 L.J.M.C. 97; 3 B. & S., 341; 9 Jur. (N.S.), 746; 11 W. R., 263; see also Powell *v.* Newport, 27 J. P., 389.

The Court held that the expenses must be apportioned among all the owners of premises fronting, adjoining, or abutting on the street in proportion to the frontage without any reference to direct or consequential benefit which the Act assumes must be taken as proportioned to the frontage. Therefore a railway and canal company whose premises lay along one side of a street were held liable to pay their proportion of the expenses, although they had no immediate access to the street.

Manchester *v.* Chapman. 18 L. T. (N.S.), 640; 16 W. R., 974; 37 L. J. M. C., 173; 32 J. P., 582.

The owner of the ground at the end of a street forming a *cul-de-sac* was held liable to pay the expenses of paving, &c., under a local Act, notwithstanding that a wall divided his property from the street, which wall, however, he might at any time remove wholly or partially, so as to obtain access to the street.

See also Sheffield *v.* Fulham, D. B. W.; 1 Ex. D., 395.

Newport Sanitary Authority *v.* Graham. 9 Q. B. D., 183; 47 L. T. (N.S.), 98; 31 W. R., 121; 47 J. P., 133.

A. was the owner of three houses fronting a street called York Place and adjoining or abutting at the rear upon a footpath at the end of a street called S. Julian Street which formed a *cul-de-sac*. The ground at the back of these houses was 5 feet above the level of S. Julian Street, and the wall, which was the property of A., was about 12 feet high on the outside. There was no access from A.'s premises to S. Julian Street. It was held that his premises adjoined or abutted on S. Julian Street within this section.

Paddington (Vestry of) *v.* Bramwell. 44 J. P., 815.

B. was the owner of a house which had its front and only entrance in F. street, and behind it a garden with a dead wall at the further end. A new street was made parallel to F. street, of which the dead wall at the end of B.'s premises was part of the line of street. It was held that B.'s land abutted on this new street.

Under the Metropolis Management Acts. W. having a strip of land about 4 inches wide and 265 feet in length abutting upon the north side of a new street, had erected a boundary fence upon the land along its whole extent under a covenant to erect and for ever after maintain a fence thereon made with his vendor who was owner of the land adjoining the strip on the north side. Held that W. was the owner of the strip of land within the meaning of 25 and 26 Vict., c. 102, s. 250, and therefore liable to contribute towards the expense of making the new street.

Williams *v.* Wandsworth Board of Works 13 Q.B.D. 211; 53 L. J. M. C., 187; 32 W. R., 908; 48 J. P., 439.

Appellant owned premises separated from a street by a wall 5 feet high belonging altogether with the land in which it stood to another person. The appellant had no direct access from his premises to the street, but in order to reach it had to pass for a short distance down a public passage or over other intervening land. Held that the appellant was not the owner of premises "fronting, adjoining, or abutting on the street" within the meaning of the section, and therefore was not liable to contribute to the expenses of sewering and paving the street under that section.

Lightbound *v.* Bebbington Local Board. 14 Q.B.D. 849; 54 L. J. M. C., 130; 33 W. R., 705; 49 J. P., 678; affirmed in C.A. W. N., 1884, p. 224; 55 L.J.R. M. C., 94.

The premises of L. were divided from D. street by a small stream, but connected with it by means of two bridges over the stream, having gates which L. could close and thereby shut off all communication. One of the bridges had been removed and reinstated by L. The principal outlet from L.'s premises led into W. street. Held that he fronted and abutted on D. street within the meaning of the section.

Wakefield Local Board *v.* Lee. L. R. 1 Ex. D., 336.

The soil of private roads leading out of a new street was held to be land "bounding or abutting on such street." But in this case Lord Northbrook had determinately reserved the property to himself, he had not dedicated them to the public, and nothing that he had done was past recall. Therefore in a subsequent case this decision was distinguished.

Lord Northbrook *v.* Plumstead Board of Works. L.R.7 Q.B.,183; 41 L. J. M. C., 51; 25 L. T. (N.S.), 461; 20 W. R., 177; 36 J. P., 468.

Here the land company being owners of certain lands in 1863 laid them out for building purposes, and made roads and ways across them, and nearly the whole of the estate was sold in lots to different purchasers. Each lot had a frontage upon one of the roads. The roads had been dedicated to the public as far as any act of the defendants could do so, but no proceedings were taken to make them repairable by the parish. The plaintiffs, the Board of Works for the district, from time to time paved the new streets formed by the houses on the estate, and apportioned the cost among the owners of land bounding and abutting on the street. In so doing they assessed the defendants in respect of the new streets or roads when these bounded or abutted on

Plumstead Board of Works *v.* British Land Company. L. R. 10 Q. B., 203; 44 L. J. Q. B., 38; 32 L. T. (N.S.), 94; 23 W. R., 634; 39 J. P., 376; reversing

L. R. 10 Q. B., 16; 31 L. T. (N.S.), 752; 23 W. R., 133; 39 J. P., 133.

the sides or ends of the streets paved, as being lands abutting on those streets within 25 and 26 Vict., c. 102, s. 77. It was held by the Exchequer Chamber that assuming the property in the soil of the roads to be in the defendants, they were improperly charged, for that they were not, in respect of roads which had been irrevocably dedicated to the public, the owners of land within the meaning of the section.

Vestry of S. John, Hampstead *v.* Cotton. 49 J. P., 567.

The owner of the soil of a road dedicated to the public is not the owner of lands abutting on the street into which such road opens.

Wright *v.* Ingle. W. N., 1885, p. 210.

Under the corresponding sections of the Metropolis Management Acts, the trustees of a Wesleyan chapel were held to be owners of the chapel, and that the chapel was a house or land abutting on a new street.

Decision affirmed in C. A., see 55 L. J. R.M.C., 17.

A place of meeting of a congregation not of the Church of England, vested in trustees in trust for use for purposes of religious worship, being only made incapable of being a habitation for man by convention *inter partes*, and not by common law or statute, is a "house" within the meaning of the Metropolis Management Act 1855, and the trustees are liable to contribute to the expense of paving a new street on which it abuts.

Willesden L. G. B. Report 1884–5, p. lxxxv.

Found that the premises could not be said to front, adjoin, or abut on the street. Ordered that the appellants should not be required to pay the sum demanded.

Partial Works.

Whitchurch *v.* Fulham Board of Works. L. R. 1 Q. B., 233; 12 Jur. (N.S.), 353; 35 L. J. M. C., 145; 14 W. R., 277; 13 L. T. (N.S.), 631; 30 J. P., 229.

It was held with reference to the Metropolis Management Acts (18 and 19 Vict., c. 120, s. 105, and 25 and 26 Vict., c. 102, s. 77) that although the District Board might have resolved that part only of a road should be repaired, there could be only one apportionment on all the owners along the entire road. Therefore when the surveyor had divided the road into four sections, and apportioned each section amongst the owners of property in each section respectively, it was held that such apportionments were bad, and could not be enforced.

Wakefield Corporation *v.* Mander. L. R. C. P. D., 248.

Where an Urban Sanitary Authority acting under this section repaired the footway on one side of a street, and apportioned the whole cost among the owners and occupiers of premises on that side only:—Held that the apportionment was right.

Sewer.

Fulham District Board of Works *v.* Godwin.

Where an owner had with the sanction of the Metropolitan Board of Works, under 25 and 26 Vict., c. 102, s. 44, laid down a sewer in a new street, and the District Board afterwards took up this sewer and

laid down another for the drainage of the neighbourhood, it was held that the owner could not be charged with any portion of the expense of the second sewer.

1 Ex. D., 400; 35 L. T. (N.S.), 907; 41 J. P., 134.

Question was whether the owners should be required to pay the expenses of a sewer, the construction of which was expedient in the interest of the neighbourhood, but which was more costly than was necessary for the effectual drainage of the particular properties owned by the appellants.

Considered that it would be equitable for the owners to pay one-half of the cost of the sewer in question, and ordered accordingly.

Withington L. G. B. Report 1882–3, p. xciv.

Levelling Streets.

The power given by this section only attaches where the particular street requires to be levelled, &c., looking at it as an isolated street. Where therefore the Local Board had required the owner of a house to level the part of a street upon which his house fronted, so as to make it on a level with other streets, it was held they could not recover from him the expenses incurred by them in doing the work.

Caley *v.* Kingston-upon-Hull Local Board. 34 L. J. M. C. 7; 5 B & S., 815; 11 Jur. (N.S.), 171; 13 W. R., 143; 11 L. T. (N.S.), 339; 29 J. P., 116.

Lord Chief Justice Cockburn said: "Under the words of the 69th section the Board has no power to require the appellant to raise the footpath to the level of the adjoining streets. The object was to make each street uniform, and it must be looked at as one isolated street so far as this question is concerned. If there are inequalities in it, there is power to make it level. It may be that it would be a convenience for the neighbourhood if this street was made of the same level as those near it, but there is no power to throw the expenses of doing so upon the owners."

Deposit of Plans and Estimates.

The deposit of these plans is not a condition precedent to the recovery of expenses from the owners.

Cook *v.* Ipswich Local Board. L. R. 6 Q. B., 451; 44 L. J. M. C., 169; 24 L. T. (N.S.), 579; 19 W. R., 1079; 35 J. P., 565.

The County Court Judge held that payment under this section could not be enforced on the ground that the opportunities afforded to the defendant of inspecting the documents deposited were not reasonable, the bye-laws of the Local Board having provided that the office of the Board should be open only on Mondays and Thursdays from 10 till 3. The High Court reversed this decision, on the ground that the provision as to deposit of plans was directory only, and was not a condition precedent to the recovery of expenses.

Shanklin Local Board *v.* Miller. S. C. P. D., 272; 49 L. J. C. P., 512; 42 L. T. (N.S.), 788; 29 W.R., 63; 44 J. P., 635.

Penarth L. G. B. Report 1883–4, p. xcvii.

The decision of the Local Board was upheld, except as regards a small sum representing a proportion of the cost of the footpath not provided for in the estimates published by the Local Board.

Cunningham *v.* Wolverhampton. L. R., 26; L. J. M. C., 33; 7 E. & B., 107; 3 Jur. (N.S.), 385; 21 J. P., 262.

Before entering into a contract for the execution of work for the Local Authority under this section, it is not necessary to obtain an estimate from the surveyor as to future repairs under Section 174, Sub-section (3); nor is such report a condition precedent to the right to recover the amounts apportioned on the several owners.

Default of Owners.

Worthington *v.* Sudlow. 31 L. J. Q. B., 131; 2 B. & S., 508; 8 Jur. (N.S.), 668; 10 W. R., 621; 6 L. T. (N.S.), 283; 26 J. P., 453.

Owners having made default, the Local Board of M. made a contract with W. to do the work for them, the work to be done within four calendar months after the signing of the contract, and the contractor to be paid for the work when the money was collected from the owners of the adjoining property. The Local Board had unintentionally given bad notices, and were therefore unable to collect the money from the owners. W. having done the work contracted for, brought an action against the Local Board for the amount due to him by the contract. It was held that he was entitled to recover, as an undertaking must be implied on the part of the Local Board that they were in a position to collect the money from the owners and pay it over to him.

Worthington *v.* Hulton. L. R. 1 Q. B. 63; 6 B. & S., 943; 12 Jur. (N.S.), 73; 35 L. J. Q. B., 61; 14 W. R., 632; see also Worthington *v.* Sudlow. 30 J. P., 22.

The plaintiff had in 1858 entered into contracts with a Local Board for the execution of works under this section, to be paid for out of money to be collected from those on whom the works were chargeable under the Act. The contracts were duly performed by the plaintiff. The notices given by the Board turned out to be bad, and many of those who would otherwise have been liable refused to pay the sums assessed upon them. This became known to the plaintiff in 1860, and he thereupon demanded payment. The Board were in hopes of being able to collect the money notwithstanding the invalid notices, and by November 1860, 800*l.* was collected and paid over to the plaintiff, leaving a balance due of more than 3000*l.* The plaintiff commenced an action for this sum and obtained judgment, and within six months afterwards he commenced an action claiming a writ of *mandamus*, commanding the Board to levy a rate to satisfy the judgment. It was held that the delay in commencing the original action was excused, and shown not to be undue, and that a peremptory writ might be granted.

See Cunningham *v.* Wolverhampton, *supra*.

Hall *v.* Batley.

This case was decided with reference to Section 23, but the principle laid down in it appears to be equally applicable to this section. In that case Justice Lush said: "It is not permitted to them (the Local Authority) arbitrarily to interfere and do the work at the owner's expense, without first giving him the opportunity of doing it himself. But if they were to do so, he is the only person who could complain.

The Act requires that the work shall be done by the one party or the other, and surely the owner may waive the option given him by the Act if he pleases, and agree with the Urban Authority that the drain shall be made by them as if the preliminaries had been observed."

Lewis *v.* Cardiff Corporation. 47 Law J. R. M. C., 101.

An owner of premises abutting on a street, having received from an Urban Sanitary Authority notice under this section to pave, &c., such street, endorsed on the notice an authority to them to execute the works, and an undertaking to repay the costs on completion. On default of payment after demand made, the authority proceeded to recover the expenses in a summary manner before justices. Held that owner having by the submission endorsed on the notice admitted the right of the Sanitary Authority to issue the notice, could not require proof to be given before the justices of fulfilment of the conditions precedent to the existence of such right. The owner could not by such submission give jurisdiction to the Sanitary Authority if in fact they had none, but he did thereby waive the proof of the preliminaries to the notice, and made it incumbent on himself to disprove their original authority if he wished to disprove it. It was therefore open to him to show that the street was not a highway repairable by the inhabitants at large.

Recovery of Expenses.

Vestry of S. Pancras *v.* Batterbury. 26 L. J. C. P., 243; 2 C. B. (N.S.), 477; 3 Jur. (N.S.), 1106; 21 J. P., 424.

It is to be observed that where a statute provides a method of recovering such expenses an action will not lie, the remedy given by the statute being exclusive.

Mayor of Blackburn *v.* Parkinson. 28 L. J. M. C. 7; 1 E. & E., 71; 5 Jur. (N.S.), 572; 22 J. P., 751; 33 L. T. (O.S.), 119.

By a special Act incorporating the Railway Clauses Act, 1845, and the Towns' Improvement Clauses Act, 1847, it was enacted that certain expenses incurred by the commissioners in paving streets might be recovered as damages. An action having been brought to recover expenses so incurred, it was held that such action was not maintainable, for that the proper construction of the several Acts was that the expenses were to be recovered as damages on a proceeding before justices under Section 210 of the Towns' Improvement Clauses Act.

Lister *v.* Hebden Local Board. 42 J. P., 119.

Summary proceedings having been taken against an owner for payment of his proportion of the expenses, the justices made an order on him in default of distress, to be imprisoned with hard labour. As the justices had no power to order hard labour, the Quarter Sessions on appeal quashed the order without going into merits. Afterwards the Local Authority obtained a new order to pay the same amounts. It was held that the justices had jurisdiction to make the new order, the former having been quashed as null and void.

Ashworth *v.* Hebden Bridge Local Board. 47 L. J. Ch., 195; 37 L. T. (N.S.), 496.

Orders having been obtained by a Local Board for payment, by A. and L. and others, of certain paving expenses incurred under this section, an agreement was come to that the order against L. should not be enforced for three months, in order to enable a case to be stated for the opinion of the Court of Queen's Bench on a point of law. An understanding was at the same time come to that the order against A. should abide the decision in L.'s case. L., instead of taking the case to the Queen's Bench, went before the Quarter Sessions, and the order made against him was quashed on a technical ground (see Lister *v.* Hebden, *supra*). A. was not informed of the course taken by L., and the three months having expired within which she should have appealed, the Local Board obtained an order against her for the payment of the rate. On motion by A. to restrain the Board from enforcing the order until she had an opportunity of stating a case for the opinion of the Court of Queen's Bench, it was held that the Court had power to restrain the Board from enforcing the order, and on A. undertaking to consent to a case and to pay the money into Court, the injunction was granted.

Greece *v.* Hunt. 46 L. J. R. M. C., 202; L. R. 2 Q. B. D., 389; 36 L. T. (N.S.), 404; 25 W. R., 543.

The council of a borough gave notice to the respondent as well as the other owners of property abutting upon a street (not being a highway) to pave, &c. the same, under the provisions of 11 and 12 Vict., c. 63, s. 69, and such notice not having been complied with, executed the work and had the expenses apportioned by their surveyor among the owners according to their frontage. Notice of such apportionment was served upon the respondent on 12th April, 1875, and not being disputed within three months became binding on him under Sect. 63 of Local Government Act, 1858 (21 and 22 Vict., c. 98). On 31st July the council, who had never declared the expenses to be private improvement expenses, served the respondent a notice demanding payment, and within six calendar months afterwards preferred a complaint before the justices for a recovery of the sum due by 11 and 12 Vict., c. 43, s. 11. A complaint where no time is limited must be made within six months from the time when it arose. Held that a notice of demand was necessary, and that the six months under 11 and 12 Vict., c. 43, s. 11, began to run from the service of such notice.

Jacomb *v.* Dodgson. 32 L. J. M. C., 113; 3 B. & S., 461; 9 Jur. (N.S.), 848; 11 W. R., 308; 7 L. T. (N.S.), 674; 27 J. P., 548.

The provisions of 11 and 12 Vict., c. 43, s. 11, which limit the time within which proceedings can be taken before justices to a period of six months from the time when the matter of complaint arises, applies to the recovery of these expenses by summary proceedings, but the six months do not begin to run till after the expiration of the three months during which the apportionment may be disputed under Section 257.

See also per Lush, J., in Wilson *v.* Bolton, and the judgments in West *v.* Downham.

When a notice of apportionment was a nullity and a second and valid notice was afterwards given, it was held that the time did not begin to run until after the second notice.

Sykes *v.* Huddersfield.
35 J. P., 614.

The works were done and the amount apportioned in June 1876, but no demand was made on the owner until the 31st December, 1879. It was held that a summons for payment was in time when brought on 14th May, 1879.

Marr *v.* Greenwich Board of Works.
44 J. P., 424.

See also Tottenham Local Board *v.* Rowell, p. 69.
West Ham „ „ *v.* Maddam.

If the complaint to recover the expenses is made in time, it is no objection to the validity of a summons that it is issued more than a year after such complaint.

Simcox *v.* Handsworth.
Ante, p. 58.

In this case, heard by the County Court Judge of Liverpool (F. J. Collier, Esq.), work had been done by a Local Board under this section, and notice of apportionment was served on 29th March, 1878. On the same day a demand of the amount was served. Proceedings to recover the amount were instituted in the County Court on 7th October, 1878, and it then transpired that a second demand had been made on the 6th August. His Honour in a considered judgment held that the first demand was a nullity, as there was no liability to pay until the expiration of three months after notice of apportionment. The second demand was therefore a good one, and the proceedings were in time. This he considered to be the result of Greece *v.* Hunt. In Wilson *v.* Bolton (Mayor of) the notice of apportionment and the demand of payment had been served at the same time, but no objection was taken in argument on that ground, and so far as it was inconsistent with Greece *v.* Hunt it must be considered to be overruled.

West Derby Local Board *v.* Bell.
42 J. P., 812.

In this case where the justices declined to make an order for the payment, the Board applied for and obtained a case under 20 and 21 Vict., c. 43. The respondent took no part in the statement of case, and did not appear in support of the justices' decision. The Court decided in favour of the appellants, and it was held that the respondents might be ordered to pay the costs of the appeal.

Wednesbury Local Board *v.* Stephenson.
33 L. J. M. C., 111;
10 Jur. (N.S.), 151;
12 W. R., 414;
9 L. T. (N.S.), 731;
28 J. P., 261.

It was held that when owners were liable for paving expenses under 18 and 19 Vict., c. 120, s. 105, and 25 and 26 Vict., c. 102, s. 77, the vestry could not in their discretion charge the expenses upon the general rates. See also per Jessel, M.R., in Taylor *v.* Oldham Corporation, *ante*, p. 56.

Dryden *v.* Putney (Overseers of).
1 Ex. D., 223;
34 L. T. (N.S.), 69;
40 J. P., 263.

Attorney-General *v.* Wandsworth District Board of Works. 6 Ch. D., 539; 46 L. J. Ch., 771.

Accordingly the District Board were ordered to restore to the general rate the amount they had in fact so expended, and to levy the same upon the owners of adjoining houses and land according to the Act.

Acton L. B. *v.* Lewsey. 55 L. J. R; Q. B. D., 404.

The appellants gave notice to respondent to pave part of a street. The notice prescribed the manner in which the work was to be done, and in particular required concrete to be laid under the footway. The respondent failed to execute the work, and the appellants thereupon did it themselves, but omitted the concrete, which was found to be unnecessary. Held that the appellants were not by such deviation from the terms of their notice precluded from recovering from the respondent his proportion of the expenses.

Incidental Works.

Poplar Board of Works *v.* Love. 29 L. T. (N.S.), 915; 38 J. P., 246.

The Board were held entitled to recover as costs incidental to the paving, &c., under this section, the costs of serving the notices of apportionment, obtaining names of owners, collection of amounts, advertisements, and printing expenses. This decision was given with reference to 25 and 26 Vict., c. 102, s. 77, which enables the Board to recover all incidental costs and expenses.

As to the effect of the refusal to order expenses on the ground that the street is a highway, &c., upon a subsequent application under this section, see Reg. *v.* Hutchins, p. 56.

In a case in which a Local Board were held to be estopped from proceeding summarily, see Gould *v.* Bacup Local Board, p. 58.

As to the right to recover from a Local Board sums paid under this section by mistake, see Midland Railway Co. *v.* Withington Local Board.

Charge on the Premises.

Plumstead Board of Works *v.* Ingoldby.

Successive owners are liable until the charges are reimbursed with interest.

West *v.* Downham, see p. 75.

Though the owner is personally liable in so far as summary proceedings may be taken against him, yet the words of the text which make the expenses a charge on the premises do not create a personal liability. Accordingly the Court of Appeal refused leave to prove for them in an administrative action.

The proceedings under 24 and 25 Vict., c. 61, s. 24, in the County Court for the recovery of a demand below 20*l.* having been taken after the expiration of six months from the time when such demand became due. Held (affirming the judgment below) that such proceedings (being authorised in substitution at the option of the Local Board for proceedings before two justices) were by implication subject to the limitation fixed by 11 and 12 Vict., c. 43, s. 11, in respect of such last-mentioned proceedings.

Tottenham Local Board *v.* Rowell. 46 L. J. R. Ex., 432; Law Rep. 1E.D. 511.

In 1864 the plaintiff Board, under the powers of the Public Health Act, 1848, incurred certain expenses in execution of certain works in the street adjoining R.'s premises. For which expenses he as owner (among others) became liable under Section 69 of that Act, which the Board by a resolution declared to be private improvement expenses, and for which, under the powers of Section 90 of that Act, they levied on the owners and occupiers a private improvement rate payable by annual instalments. These expenses constituted under Section 62 of the Local Government Act, 1858, a charge on the premises bearing interest of five per cent. per annum till payment. In 1872 they revoked the resolution, and made a fresh rate for the whole amount remaining unpaid to be paid by the owners and occupiers. R. not having paid this rate, the Board in 1875 brought an action against his representatives (he having died in 1874) to enforce the charge on his property. Held (reversing Malins, V.C., 49 Law J. Rep. Chanc. 147) that the charge under the 62nd section constituted an additional and not an alternative remedy, and that the bar of six months which applied to the summary remedy against the person before the justices and also in the County Court did not apply to the additional remedy of enforcing a charge on the property, and that the Board were not precluded by their election to treat their expenses as private improvement expenses from enforcing the charge, but that only in respect of the instalments for the time being in arrear.

Same suit. 50 L. J. Rep. Chanc., 99; Law. Rep., 15 Ch. D., 378.

This section imposes a charge on the premises immediately the expenses are incurred, and there is no limitation of time during which that charge is to remain effective. The condition upon which the charge is made to arise is nothing but this, "where the Local Board have incurred expenses for the repayment whereof the owner is made liable." Directly therefore the Local Board have incurred such expenses, the section must be read as if immediately after that there came these words, "such expenses shall be a charge on the premises." Therefore directly from the moment the expenses which are named in that section have been incurred, such expenses are a charge on the premises, that is, the charge is imposed then and there by the statute. Moreover the phrase is grammatically a phrase of addition, because the earlier part of the section names the other remedies to which the Board may resort, and it adds the words "and such expenses shall be a charge on the premises." Therefore it seems to me that upon the reading of that

Lord Justice Brett's "decision" on the last case.

section there is a charge the moment the expenses are incurred, and it is a charge which exists although other remedies exist at the same moment that that commences, or other remedies may by different processes be made to arise either as against the owner, who is in the first place the person liable, or as against other persons. It is true that the owner is liable to another remedy the moment the expenses have been incurred which he ought to have defrayed himself. There is a remedy against him personally for the whole sum, which remedy is to be enforced within six months; but if the Board claim the whole payment from him at once, yet fail to recover it from him personally, and there are no means of recovering it from him by distress, or if they pass by the personal remedy, then if they have done nothing to prevent them from putting the charge into effect, I see no reason why the charge might not then and there be put into effect for the whole sum as against the owner. But the Board has also the power of causing other remedies as against other persons to arise. They may declare the expenses to be private improvement expenses. That is the first resolution which they may pass. Having done that, they may deal with that in one of two ways. Having declared the expenses to be private improvement expenses, they may make a private improvement rate, and if they do so they at once have a remedy against the occupier, and the occupier is given a remedy over against the owner to some extent. If they do make an improvement rate, they can only put their remedies upon that rate into effect under what are called Jervis's Acts, and if they do attempt to put their remedy into effect against the occupier, they are at once as against him limited in time. They may not only attempt to use the summary remedy, and then the decision in Tottenham Local Board *v.* Rowell (1 Ex. D., 514; 46 L. J. Q. B., 432; 35 L. T. (N.S.), 887; 25 W. R., 135), which if I may venture to say so was perfectly right, is that the same limit of time applies. But that limit only affects remedies which they have as against the occupier or owner personally by summary proceedings. Well, having declared those expenses to be private improvement expenses, there is another mode in which they may deal with it. They may come to a resolution that the whole sum shall be divided into instalments and spread over a certain number of years not exceeding thirty. If they do that, that at once gives them remedies against the occupier and against the owner. Having made the sum payable by instalments, they could not retract that, and insist, either by putting the charge into effect or otherwise, upon an immediate payment of the whole. Having once made the sum payable by instalments, it must so remain: but then it being payable by instalments they have a summary remedy against the occupier or against the owner as each instalment falls due. Although they have all these, the owner may be unable to pay, and there may not be sufficient to enable them to recover by distress: all those remedies may fail, but if they do fail it seems to me that there is nothing which upon the failure of these remedies has done away with that charge, which existed from the beginning, and which is not limited

in time upon the arising of any condition subsequent by any words in the Act from the beginning to the end; but when the payment has come to be a payment by instalments, then I think that if the charge is to be made effective it could only be made effective for instalments in arrear. All the remedies which are either existing at the time when the charge takes effect, or which are by following the forms of the statute made to arise after that charge has taken effect, have nothing to do with the charge—they make it neither greater nor less. If these remedies fail or are not put into effect, nevertheless the charge which exists absolutely independently of them may always be made effective by the process of the Court, and there is no limitation of time as to that, except, I suppose, the ordinary statutes of limitation.

In an action to recover from the defendant his proportion of the cost of paving, &c., a street under this section, it appeared that part of the work to an amount exceeding 50*l.* had been done by contractors employed by the Local Authority, but that no written contract under the common seal of the Authority had been made with them as provided by Section 174. Held by Hawkins and Smith, J. J., that the defendant was nevertheless liable. By Smith, J., that the objection if valid would have been an objection to the apportionment which could only be raised in the time and manner provided by Section 257.

Bournemouth Commissioners *v.* Watts. 14 Q. B. D., 87; 54 L. J. Q. B., 93; 51 L. T. (N.S.), 823; 33 W. R., 280; 49 J. P., 102.

An action was brought to enforce a charge on premises under this section of 6*l.* 19*s.* 10*d.* No summary proceedings had been taken to recover the money, and for that reason as well as having regard to the small sum claimed, Kay, J., refused to entertain the action, and dismissed it with costs against the Local Board.

Westbury on Severn R. S. A. *v.* Meredith. L. J. M. C., 1885, p. 30; affirmed in the Court of Appeal, W. R., p. 163 (1885); 52 L. T. (N.S.), 839.

The Authority, after executing works of improvement in private streets, had declared the expenses so incurred to be private improvement expenses, and had made a rate to defray the expenses. On appeal the Local Government Board cancelled the decision of the Urban Authority and declared that the expenses already incurred and to be incurred by them should be recovered in a summary manner from the owners, and directed that any order which might be made by the Urban Authority under the last paragraph of Section 257 should provide for the repayment by half-yearly instalments not exceeding eleven in number.

Goole L. G. B. Reps., 1881–2, p. lxxxix.

This case was an appeal by the trustees of the Free Convalescent Home at Woodford against the decision of the Urban Authority with respect to the cost of making up the street adjoining the home. The Local Government Board modified the decision, and required them to repay to the trustees a sum which in the opinion of the Local Government Board was in excess of that which was equitably chargeable upon the trustees.

Woodford L. G. B. Reps., 1881–2, p. lxxxix.

Widnes L. G. B. Reps., 1882–3, p. xciv.

Decision was that the appellant ought to pay the amount claimed as an equitable sum after the Local Government Board had deducted some small sums for interest and establishment charges.

Leigh—Ibid.

A charge for interest accruing prior to the date of demand was disallowed.

Derby L. G. B. Reps., 1883–4, p. xcvii.

Objection taken by appellants was that besides the actual cost of the works 10 per cent. had been charged by the town council in respect of "incidental expenses." The Local Government Board directed one of their inspectors to hold a local inquiry on the subject of the appeal, and as no satisfactory information was supplied as to the expenses in respect of which the 10 per cent. had been charged, it was decided in favour of the appellants so far as regards the sum which this percentage represented.

Chiswick—Ibid.

Owner appealed against the charge sought to be recovered from him by the Improvement Commissioners for commission and interest, and the Local Government Board decided that no interest could be charged to the appellant before the date of service of demand upon him, and that the charge for commission was excessive, and an order was issued in conformity with this view.

Northwich L. G. B. Reps., 1883–4, p. xcvii.

Two appeals were made by owners or occupiers of property in the Local Government district of Northwich against decisions of the Local Board in the matter of certain private improvement expenses. In one case the appellants alleged that the work in respect of which the claim was made upon them was done in a faulty manner and not according to the specification drawn up by the Local Board, and in the other the owner submitted that he had done the work himself to the satisfaction of the Local Board, and that the Local Board had subsequently taken up and relaid part of the work and charged not only for such work but for work done for another owner. The Local Government Board considered that the appellants could not equitably be called upon to pay the amounts demanded from them.

Liability of Owner for Expenses.

Bermondsey (Vestry of) *v.* Ramsey. L. R. 6 C. P., 247; 40 L. J. C. P., 206; 24 L. T. (N.S.), 429; 19 W. R., 774; 35 J. P., 567.

The Metropolis Management Act, 1862 (25 and 26 Vict., c. 102), ss. 77 and 96 make the paving expenses recoverable by action from the present or future owners of the premises or from any person who then or thereafter occupies the premises. The vestry of B. had recovered a judgment against a former owner of premises in respect of such expenses which remained unsatisfied. It was held that such judgment was no bar to a subsequent action against the defendant, who occupied the premises as tenant to a succeeding owner.

Under the same Act it was held that the expenses might be recovered from the mortgagee in possession as owner, notwithstanding that another person was owner at the date when the improvement was resolved upon; and that the expenses were a charge on the premises (see Sec. 257), and that the amount ought to be recovered from future owners although there had been no arrangement to accept payment by instalments.

Plumstead Board of Works *v.* Ingoldby and others (Trustees of Planet Building and Investment Society). L. R. 8 Ex. 174; 42 L.J.Ex. 136; 29 L. T. (N.S.), 375; 21 W. R., 817; 37 J. P., 759; affirming L. R. 8 Ex., 63; 42 L. J. Ex. 50; 27 L. T. (N.S.), 656; 31 W. R., 77.

Where an owner of premises, having received a notice from the Urban Sanitary Authority under Section 150 of Public Health Act, 1875, to pave, &c., the street adjoining his premises, fails to comply with the same, and afterwards the Local Authority execute works, but after the work was begun by the Local Board and before the completion of it the owner sells the premises. He ceases upon such sale to be an "owner in default," and cannot be ordered to pay the expenses incurred by the Local Authority in executing the works, such expenses being by Section 257 recoverable only from the person who is owner of the premises when the works are completed. Lord Chief Justice Cockburn said: "I cannot think it was ever intended by the Legislature that when the owner has parted with his property and somebody else is in possession of it and therefore getting the benefit of the work done, and who ought therefore to pay the expenses incurred, it should be competent for the Local Authority to follow him up wherever he may have gone and hold him personally liable. I think that defect is remedied by Section 257, which treats of owners upon whom notice was originally served, and who are owners at the time the work is completed and the expenses demanded, as the persons upon whom the Local Board shall be able to come for the expense."

Reg. *v.* Swindon Local Board. 4 Q. B. D., 305; 48 L. J. Q. B., 119; 40 L. T. (N.S.) 424; 27 W. R., 732; 43 J. P., 431.

An apportionment was made and notice given to the owner that his proportion was 20*l.* 2*s.* He did not pay, and a complaint was made before justices, when it was objected that the apportionment was bad, on the ground that the expenses of the two streets had been lumped together and the aggregate amount divided among the owners in the two streets, and the justices dismissed the complaint on that ground. The surveyor then made a fresh apportionment, and a notice was served on the owner that his proportion was 19*l.* 11*s.* He gave notice that he disputed the apportionment, and the matter came before justices under a section corresponding to Section 181. On a case stated by the justices, it was held that the first apportionment was a nullity, and the surveyor not being *functus officio* was right in making a fresh apportionment.

Cook *v.* Ipswich Local Board. L. R. 6 Q. B., 451; 44 L. J. M. C., 169; 24 L. T. (N.S.), 579; 19 W. R., 1079; 35 J. P., 565.

Sykes *v.* Huddersfield. 35 J. P., 614.

Where an apportionment was signed by B., who was not then surveyor, having been suspended previously, the Board on discovering the mistake issued a fresh notice and apportionment signed by their actual surveyor, treating the former notice as a nullity. It was held that the Board had acted properly

St. Helens *v.* Riley. 47 J. P., 471.

Where a local Act enacted that the proportion in which the expenses were to be apportioned was to be ascertained and settled by the Corporation, it was held that the fact that the apportionment had been corrected by the surveyor to the Corporation after it had been approved by the Corporation did not invalidate it.

Shanklin Local Board *v.* Miller. 5 C. P. D., 272; 49 L. J. C. P., 512; 42 L. T. (N.S.), 788; 29 W. R., 63; 44 J. P., 635.

An apportionment of expenses duly incurred by a Local Board in the paving of streets was served on the owner of premises fronting the same. The apportionment mixed up the expenses of more than one street, but the owner not having objected within the three months provided by Section 257, it was held that it was too late to raise an objection to the apportionment, which thenceforward became valid and binding. The deposit of plans and estimate of the works intended to be executed under Section 150, and by that section directed to be made for the inspection of all persons interested, is not a condition precedent to the validity of subsequent proceedings.

Mr. Justice Denman, referring to the decision in Cook *v.* Ipswich, said it was not intended to decide "that an apportionment which is otherwise good on the face of it, is necessarily a nullity and may be treated as such in any Court before which it may come because two streets instead of one are included in the apportionment, but the Court meant this, viz., that when that is the case and the parties have come to the conclusion that the apportionment cannot be enforced and the surveyor makes a fresh apportionment, the former one becomes a nullity in the sense that it cannot be enforced and is useless for particular purposes and cannot stand in the way of a good apportionment. That is to my mind the full extent of the decision, and it is not a decision that if no steps are taken to set aside or dispute the apportionment on the ground that the party charged is not liable it may be treated as a nullity when it comes before the Court."

Mile End (Vestry) *v.* Whitechapel (Guardians). 1 Q. B. D. 680; 46 L. J. M. C., 138; 35 L. T. (N.S.), 354; 24 W. R., 719; 40 J. P., 565; affirming 45 L. J. M. C., 75; 34 L. T. (N.S.), 178; 24 W. R, 364.

Buildings and land belonging to the defendants abutted on a new street which a metropolitan vestry ordered to be paved over half its breadth, only the part paved being that nearest the defendants' premises. The vestry apportioned the whole cost of paving upon the houses forming the defendants' side of the street, omitting those on the other side. It was held that the apportionment was invalid, and that the owners on both sides of the street ought to have been charged. This decision was given with reference to the Metropolis Management Act, 1862 (25 and 26 Vict., c. 102), s. 77, which imposes a liability on the owners of houses forming the street and on the land bounding and abutting on such street.

The footpath was paved on one side of a street, and the cost apportioned among the owners on that side only. It was held that the apportionment was right. Wakefield *v.* Mander. L. R. 5 C. P. D., 248; 28 W. R., 922; 44 J. P., 522.

The surveyor of the Local Authority, in settling the apportionment to be paid by the appellants, assessed them in respect of a frontage separated from the road in question by an embankment which belonged to another railway company. Held that as the appellants were owners of land and premises fronting, adjoining or abutting on the road, the surveyor had jurisdiction to make an apportionment; and the mistake which he made in assessing the appellants was not an excess of jurisdiction, but merely the wrongful exercise of the jurisdiction which he had to make an apportionment, and that the apportionment was binding and conclusive on the appellants unless they disputed the same as provided by Section 257 of the Act of 1875. Midland Railway Co. *v.* Watton. L. J. R. M. C. (N.S. 55, p. 99).

Arbitration.

The Authority required the defendant and other owners of land adjoining a road to pave that road, and on their failing to do so executed the works themselves, had the amount apportioned, and claimed and received from the defendant, who did not dispute the apportionment, his share of the expenses so incurred. Certain of the other owners disputed the apportionment, and an arbitration was held, of which the defendant had no notice and to which he was no party. The arbitrator reapportioned the whole sum expended amongst all the owners including the defendant, and fixed the amount to be paid by the defendant at a higher sum than had been fixed by the surveyor. In an action to recover the additional amount so charged to the defendant. Held that the plaintiffs could not recover the sum claimed on the footing of the assessment made by the arbitrator, and that the award was not binding on the defendant. Tunbridge Wells Local Board *v.* Akroyd. 5 Ex. D., 199; 49 L. J. Ex., 403; 42 L. T. (N.S.), 640; 28 W. R., 450; 44 J. P., 504.

When a notice of apportionment has been served on an owner and is met by a counter notice disputing the amount alone, such demand may be the subject of arbitration, but when the counter notice disputes the liability to pay, the liability must be determined in a manner provided by the Act, i.e. by summary proceedings (or by action in the County Court under Section 261). In such proceedings the justices or the County Court judge may exercise jurisdiction as to amount as well as liability. West *v.* Downham. 14 Ch. D., 111; 42 L. T. (N.S.), 340; 29 W. R., 6.

The text only authorises an arbitration in respect of the proportion to be borne by a defaulting owner, and not in respect of any question as to the expenses being reasonable or properly incurred by the Local Authority. Bayley *v.* Wilkinson. 33 L. J. M. C., 161; 16 C. B. (N.S.), 161; 12 W. R., 797; 10 L. T. (N.S.), 543.

Cook *v.* Ipswich, see p. 73.

Where a dispute as to the apportionment comes before justices as arbitrators under Section 181, and equally when the matter comes before them on a complaint to enforce payment, they have no jurisdiction to inquire into the question whether the amount alleged has been actually incurred. If the appellant is aggrieved by the alleged overcharge, his remedy is by appeal to the Local Government Board under Section 268.

Nesbitt *v.* Greenwich Board of Works L. R. 10 Q. B., 465; 44 L. J. M. C., 119; 32 L. T. (N.S.), 762; 24 W. R., 223; 39 J. P., 582.

It has been held with reference to the Metropolis Management Acts, 18 and 19 Vict., c. 120, s. 105, and 25 and 26 Vict., c. 102, s. 77, that the principle upon which expenses have been apportioned cannot be questioned before any tribunal.

Reg. *v.* L. G. B. 9 Q. B. D. 600; 51 L. J. M. C., 121; 46 J. P., 820; affirmed on appeal, *Ex parte* Wake, Reg. *v.* Recorder of Sheffield, 10 Q. B. D., 309; 52 L.J.M.C., 4; 48 L. T. (N.S.), 173; 31 W. R., 72; 47 J. P., 228.

A notice to pave and a notice of apportionment are not but a demand is a decision within that section, from which an appeal lies to the Local Government Board.

Wilson *v* Bolton (Mayor). L. R. 7 Q. B., 105; 41 L. J. M. C. 4; 25 L. T., 597; 36 J. P., 405.

A Local Board demanded from an owner his proportion of the expenses in January 1861. This amount not having been paid on 25th August, 1870, the Board resolved that it should be declared private improvement expenses, and in September 1870 they declared these expenses to be payable by annual instalments. It was held that the demand in 1861 amounted to an election to treat the amount due as a debt from the owner, and that they had no power to declare it to be private improvement expenses.

See also Gould *v.* Bacup, on p. 58, *ante*.
Mile End (Vestry) *v.* Whitechapel, p. 74.
Wakefield Local Board *v.* Lee, p. 61.
Dryden *v.* Putney (Overseers of), p. 67.
Attorney-General *v.* Wandsworth Board of Works, p. 68.

CHARGE ON THE PREMISES.

The charge is one not in the interest of any particular owner of the premises, but on the total ownership, that is to say on the respective interest of every owner for the time being in proportion to the value of his interest. Therefore where the owner of leasehold premises had mortgaged them for the full term less a nominal reversion, it was held that the mortgagee was liable, and Jessel, M.R., made an order that the sum claimed with interest was a charge on the mortgagee's interest in the premises.

Birmingham Corpn. *v.* Baker 17 Ch. D., 782; 46 J. P., 52.

It was held that the charge might be enforced against the owner of the premises for the time being, although he was not the owner at the time the works were completed, and although the Local Authority had omitted to enforce their summary remedy against the then owner.

Sunderland (Mayor of) *v.* Alcock. 51 L. J. Ch., 546; 46 L. T. (N.S.), 377; 30 W. R., 655.

The defendant was tenant of a public-house under a lease by which he covenanted to pay "all rates, taxes, charges and assessments whatsoever, which now are or may be charged or assessed upon the said premises or any part thereof, or upon any person or persons in respect thereof, land tax and property tax excepted."

Hartley *v.* Hudson. 48 L. J. R. Q.B., 751; L. R. Q. B. D., 367.

The plaintiff, who had acquired the lessor's interest in the premises, received a notice from the Local Authority, under the Public Health Act, 1848, s. 69, requiring him as owner to sewer, pave, level, &c., a street adjoining the premises. The plaintiff failing to comply with this notice, the Local Board executed the required work themselves, and under the above Act and Acts amending the same demanded and obtained from the plaintiff the proportion of the expenses and interest assessed in respect of those premises. Held that the plaintiff was entitled to recover these expenses from the defendant, for that such expenses were a charge upon the premises "as well as upon a person in respect thereof," which the defendant by his covenant had undertaken to pay.

See also West *v.* Downham, pp. 68, 75.
Plumstead Board of Works *v.* Ingoldby, pp. 68, 73.
Tottenham Local Board *v.* Rowell, p. 69.

NOTICE OF DEMAND.

It is only upon this notice that the Board can recover summarily and that appeal lies to the Local Government Board under Section 268, see Reg. (or Penarth) *v.* L. G. B., p. 78.

Dispute.

With reference to the conclusive character of the apportionment, see

Cook *v.* Ipswich, p. 63.
Shanklin *v.* Millar, pp. 63, 74.
Tunbridge Wells *v.* Akroyd, p. 75.
Hesketh *v.* Atherton L. B., p. 58.

Order as to instalments, see Section 257.

Summary manner, see Section 251.

Private Improvement rates, see Section 214.

Appeals.

Reg. (or Penarth) *v.* Local Govt. Bd. 10 Q. B. D. 309; 52 L. J. M. C. 4; 48 L. T. (N.S.), 173; 31 W. R., 72; 47 J. P., 228.

Notice of apportionment of expenses under Section 150 having been served upon an owner and demand of payment having been made after three months had expired the owner deeming himself aggrieved by the decision of the Local Authority addressed a memorial to the Local Government Board by way of appeal stating the grounds of his complaint. On a rule for a prohibition to the Local Government Board, it was held by the Court of Appeal that an appeal lay to the Local Government Board and that no prohibition ought to be granted. The Court held that the demand of payment was the first decision from which an appeal would lie under this section. With regard to the power of the Board on such appeal, Baggallay, L.J., said that while they might properly refuse to travel beyond the grounds of complaint alleged in the memorial, yet that they had jurisdiction to inquire into the whole matter and to inquire whether the aggregate amount of the expenses was unreasonable or unnecessary as well as whether the proportion assessed upon the appellant was right. And Brett, L.J., said it seems to me obvious from the construction of the Act that the Local Government Board have power to inquire into every circumstance however remote which could reasonably determine the question whether it was equitable or not that a particular sum should be paid. The same learned judge also expressed an opinion that the decision of the Local Government Board was judicial, and that it was their duty to hear the parties presenting the memorial, though not necessarily by hearing and evidence. It was their duty, however, to allow the appellants to know what was the answer of the Local Authority to his memorial so as to let him reply to it.

Upon the hearing of a complaint to recover expenses under Section 150 the defendant objected that the places referred to in the notice showed that part of the work had been executed upon land belonging to private owners. The magistrate found as a fact that the land did not belong to private owners, but formed part of the street when the notice was given, and made an order for payment of the amount apportioned. Upon application for a writ of *certiorari* upon affidavits which satisfied the Court that the magistrate's finding was contrary to the fact, it was held, assuming that the magistrate had jurisdiction to inquire whether the case was within the statute, that the matter was at least partly within the statute so as to give the magistrate jurisdiction, and that the remedy was not by *certiorari* (see Section 262). It was further held that the proper remedy was by appeal under Section 268 against the decision of the Local Authority.

Ex parte Wake, Reg. *v.* Recorder of Sheffield. 11 Q. B. D. 291; 52 L. J. M. C., 78; 31 W. R., 704; 47 J. P., 504; affirmed in C. A. 53 L. J. M. C., 1; 32 W. R., 82.

In the above case Smith, J., pointed out that the appellant might have obtained a case under 20 and 21 Vict., c. 43, or might have appealed to Quarter Sessions under the next section.

11 Q. B. D., 299.

The appellant was the owner of certain premises fronting Lake Place which had been sewered by the respondents in August 1884. The appellant's share of these expenses was duly apportioned by the surveyor, and the appellant took no steps to dispute such apportionment either by arbitration or appeal to the Local Government Board. In September 1885 the appellant having been summoned before justices for default in payment of the proportion charged, tendered evidence with a view of showing that the *locus in quo* was not a street within Section 150 of the Act, and that no part of the expenses which had been incurred by the respondents could be recovered from them. Held that the justices had jurisdiction to inquire into the original liability of the appellant and to decide whether Lake Place was or was not a "street" within the meaning of the 150th section.

Eccles *v.* Guardians of the Wirral Union. L. J. R. M. C. (N.S. 55, p. 106).

THE PUBLIC HEALTH ACT, 1875,—

Sections 150 and 152.

Declaration of Street which has not been Paved as Highway Repairable by the Inhabitants at large.

Attorney-General (at relation of L. B. of West Ham) *v.* Bidder and others. C. D. (before the Master of the Rolls).

In this case Mr. Chitty moved for an injunction to restrain the defendants from intercepting a certain road, named Liliput-road, in the West Ham Local Board district. It appeared that the Local Board, proceeding under their powers under Sec. 150 of the Public Health Act, gave notice to the owners of the premises abutting on this street, to sewer, level, pave, flag, and channel the same. The owners on whom the notices were served failed to execute the works, and on this default the Local Board proceeded to do the work which they deemed necessary. The street was sewered, levelled, and curbed by them, but not paved or flagged. The works undertaken by the Local Board having been completed, they caused to be posted up in the street, on the 2nd of April, the following notice:—"Whereas the street call Liliput Road, within the district of the West Ham Local Board, not being at the date of this notice a highway repairable by the inhabitants at large, has been sewered, levelled, paved, flagged, metalled, channelled, and made good, and provided with proper means of lighting to our satisfaction: Now, therefore, we, the Local Board for the district of West Ham, in the county of Essex, do hereby give notice and declare that the said street is, and from and after the date of this notice shall be, a highway, and shall be repairable by the inhabitants at large. Provided that the said street shall not become a highway so repairable if, before the 2nd day of May next, the proprietor, or the majority in number of the proprietors of the said street—in ascertaining which majority the joint proprietors shall be reckoned as one proprietor—shall, by notice in writing to the said Local Board, object thereto." Mr. Reed, who was acting for the defendants, who claimed to be the proprietors of the road, was informed of what had been done. On the 20th of April he wrote:—"I have your letter of yesterday. The posts have been put up, on my orders, where they stood before. The road is the property of the North-West Land Company, and I do not think consent will be given by them to its being dedicated to the parish at present." This, it was contended, was not a notice of objection within the section; and at the expiration of a month from the date of the notice the street was regarded by the Local Board as a highway repairable by the inhabitants at large. The defendants, however, retained a fence across this road, their reason for desiring the fence to be retained being that they were entitled to certain tolls for vehicles going to the Albert Dock, and the opening up of the Liliput Road would have afforded means for evading the payment of tolls, and consequently have diminished the income from the tolls. It was with the view of obtaining the removal of this

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Attorney-General (at relation of L. B. of West Ham) *v.* Bidder and others. C. D. (before the Master of the Rolls).

obstruction to the free passage through the street that these proceedings were taken.

The Public Health Act, by Sec. 152, provides as follows :—"When any street within any urban district, not being a highway repairable by the inhabitants at large, has been sewered, levelled, paved, flagged metalled, channelled, and made good, and provided with proper means of lighting, to the satisfaction of the Urban Authority, such Authority may, if they think fit, by notice in writing put up in any part of the street, declare the same to be a highway; and thereupon the same shall become a highway repairable by the inhabitants at large, and every such notice shall be entered among the proceedings of the Urban Authority. Provided that no such street shall become a highway if, within one month after such notice has been put up, the proprietor or majority in number of proprietors of such street, by notice in writing to the Urban Authority, object thereto; and in ascertaining such majority joint proprietors shall be reckoned as one proprietor."

Mr. ROMER, for the defendant, argued that the fence formed no part of the street. The defendant had only dedicated the road up to the fence. Further, the street had not been flagged or paved by the Local Board.

The MASTER OF THE ROLLS: I first of all deal with the notice which was given on behalf of the defendants as to the proposal to dedicate the street as a highway repairable by the inhabitants at large. I must say, if technical rules are not to be applied, there was an objection to this proposal. Notice was given by the Local Board, under Sec. 152 of the Public Health Act, and then the owners' agent sent a letter to the Local Board saying, "We cannot consent to this." He did not say, "We object." He said, "We cannot consent." My present impression is that that was sufficient as an objection. No technical form of objection is wanted. It is really reading the words most literally to treat them as an objection. As to the next point, it was argued that the 150th section and the 152nd are correlative. In my opinion they are not. The object of the 150th section is this: it entitles the Urban Authority to require the owners of a private road to do such of the works specified in the section as are necessary for the protection of the public. When a street is not sewered or is not levelled, &c., to their satisfaction, they may require the owners of the premises adjoining the street to execute these works. They may require the owners to do one or all of several works, and then they may call upon the owners to pay for the works done. That is a large power to place in the hands of an Urban Authority, and they are not to exercise it except so far as it may be necessary. Supposing that there is a small lane which has very little traffic and has a hard metalled road, and the Authority consequently do not see any necessity for its being paved, as it does very well without, but the lane requires to be lighted for the protection of the public at night; in such a case the Sanitary Authority may, under the section, require the lane to be provided with the means of lighting, and may call upon the owners of the houses to pay for it. Supposing the lane is lighted, and the Authority do not want it to be paved, but consider that there should be a sewer, they may require a sewer

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to be made, having reference to the gradients of the district and the sanitary arrangements of the inhabitants of the adjoining houses, and the owners of the houses must pay for the work. The notice is given to the owners who are liable to pay. Now, when we come to the 152nd section, it is a section of a totally different character. It is in substance this: that in certain cases, if the owners of the soil in the road do not object, the Authority may take to the road, and turn that which was a private road into a highway repairable by the inhabitants at large; subject to this, they must not do so until the road is properly formed. When this is done, of course they will be liable to repair the road ever after. Now, in the first place, it is plain that the public are to be considered. The expense of future repairs will be much greater if the road was not properly formed than if it was properly formed. The next thing to be considered is, that you are not to sacrifice the interests of the public to the interests of the speculative builder or the owner of building land. It was not intended that the public were to make roads on building land for the benefit of the building owner. He was to pay proper expenses and make a proper road, and then if it was a road beneficial to the public the Authority could take to it. Therefore the Legislature said this: "When a great many things have been done, and not till then, you may dedicate for the use of the public. When any street within any urban district, not being a highway repairable by the inhabitants at large, has been sewered, levelled, paved, flagged, metalled, channelled, and made good, and provided with proper means of lighting, to the satisfaction of the Urban Authority, such Authority may give notice of dedication." But all those things are to be done. I am told that I am not to read the section literally. I cannot read it any other way. The Legislature has pointed out what they consider a made road or street to be, and when all that is specified in the section is done, the Authority may, if they think fit, by notice in writing, dedicate the road to the public. In the present case, the street has not been flagged. It is sworn not to have been flagged; and it appears by the notice that not a single flag has been put upon the road, and nobody says that it has been flagged. That being so, how can I say that it is levelled, paved, flagged, metalled, and made good to the satisfaction of the Authority? They cannot be satisfied without this being done. If they are to be judges of it all, the Legislature would have said "When any street is made to the satisfaction" of the Authority. But that is not so. The Legislature has pointed out what must be done "to their satisfaction." The present case, therefore, in my opinion, is not within the 152nd section; because all that which is required to be done has not been done, and the notice provided for by that section is not authorised to be put up unless and until that which remains to be done has been done. On these grounds (although there are some others), it appears to me that the motion must fail upon the merits; and I shall follow my usual practice, and dismiss it with costs.

DISTRICT MEETING AT WALTHAMSTOW.

September 25th, 1886.

JOSEPH LOBLEY, M.I.C.E., President.

THE day was devoted to a visit to the sewage works at Walthamstow and to the East London Water Company's Works.

I.—THE WALTHAMSTOW SEWAGE WORKS.

The Members were received at Walthamstow by Mr. Whittington, the chairman of the Local Board, and Mr. G. B. Jerram, their engineer. The Members were first shown a system of treating sewage sludge, the invention of Mr. Astrop.

The apparatus takes the sludge as pumped over from the sewage works, and separating the solid from the liquid portion, delivers the former in a dry and portable form ready for transport as manure. The sludge first enters a trough in which are vacuum cylinders, through which the liquid sewage is to a considerable extent drawn. The solids are then carried forward on a wire gauze endless travelling apron between a series of rollers, where the moisture is further pressed out, until at the end of the series it is delivered in a comparatively dry condition into the hopper. Thence it is conducted through a shoot into a room below, where it passes through an apparatus similar to a flour dressing machine, and in which it is finally dried for the market. The drying is accelerated by a Blackman air propeller, which draws the moisture from the dressing reel. In damp weather the drying is further aided by a set of steam heating pipes placed at the end of the reel farthest from the air propeller, and using the exhaust from the steam engine. The current of air drawn through is thus warmed, and the moisture the more readily extracted.

The population of Walthamstow in 1880 was 22,000, and is now 34,000.

The district is drained on the duplicate system, that is, the soil is conveyed by the sewer to the Sewage Disposal Works at Lower Hall Farm, and the rain water off the streets is conveyed direct to the brooks and watercourses. A portion of the district being below the level of the outfall works, the sewage from the district has to be pumped. The main sewers were designed and carried out by Messrs. Swan and Gundle, also the tanks, the brick carrier, and the under draining of a portion of the land. The sewage was treated chemically by hand labour, and the sludge precipitated was removed by hand labour at a cost of about 1s. 6*d.* per ton. Owing to the increase of sewage, and the necessity of pumping the sewage from the low-level district, it was necessary to provide new arrangements for dealing with the sewage and getting rid of the sludge easily and quickly. The works lately executed comprise a low-level sewer and large underground tanks; the pipes being laid under water, it was necessary to have the joints thoroughly watertight, and this has been accomplished in bad weather and in running sand by means of Hassal's patent joints. The tank is 20 feet underground, and is 60 feet long by 35 feet wide by 6 feet 6 inches deep, and holds three days' sewage from the low-lying district. The tank is below the intake of the sewer, so that the sewers all have free outlets.

The buildings consist of an engine and boiler house, offices, and mixing shed of plain and substantial construction. A culvert is constructed, leading from each precipitating tank, whereby the sludge is conveyed through the sluices into the two sumphs. One is for the sewage from the tanks and one for the sludge. The pumps are of direct-acting type, made especially by Messrs. Hayward, Tyler & Co., and each pump is capable of pumping 10,000 gallons of sludge per hour. The steam cylinders are 10 inches in diameter, with 8-inch pumps. Each pump is so arranged that either can pump sewage to the low level into the sewer, or sludge to the high level, a lift of 45 feet. The boilers are of the locomotive type, and each one is of sufficient capacity to supply sufficient steam for all the pumps, &c., and are provided with water heater, donkey pumps, &c. In order not to attract attention, the chimney shaft is constructed low, and coke only is used for raising steam. In the engine-house is a 6 horse-power Tangye's horizontal steam engine, which is used for driving the mixing machinery and chaff-cutting machine.

The machinery for mixing the chemicals comprises a large mill

made by Messrs. Bowes, Scott, and Read, into which the chemicals, after having been weighed in proper proportions, are lifted by chain and bucket, the sewage is used for mixing, and is lifted by a small 3-inch Tangye direct-acting pump. The mixture then passes into a tank, and thence into the sewage flowing from the town. The quantity of chemicals is regulated by means of a simple arrangement designed by Mr. Jerram, and in which the varying flow of the sewage itself regulates the inflow of the chemicals. At night the sewage is treated chemically, although no one is on the works, and the engines and machines are at rest. This is accomplished by means of an ingenious arrangement of tank with automatic action inside, designed by Mr. Jerram, so as to keep the mixture well stirred up. The solids are then precipitated in the large tanks, of which there are three, each measuring 150 feet long by 30 feet wide by 6 feet deep. They are used alternately, and the clarified sewage is passed by the various conduits on to the land, by which it is filtered, flowing thence into the Dagenham Brook. The sludge is pumped into troughs laid at an inclination of 1 in 78, and by which it is conveyed a distance of 600 yards on to the land, where it is dug in. One acre is used every month, so that very little sludge is ever exposed. The land in three years will be quite ready to be used over again. The new carrier is made of 6-inch Portland cement concrete, on a bank of earth varying from 3 to 5 feet in height and laid at a gradient of 1 in 5260. The carrier is provided with sluices at short distances, and from which the sewage can pass on to various parts of the farm. The area of the farm is 160 acres, of which 100 acres are prepared for sewage arrangements. Care is taken not to let the sewage run too long in one place. The subsoil is gravel and sand, and the effluent produced is very good, as shown in the analysis. The crops are exceedingly good, those of mangolds are now being sold for 22*l.* per acre, and the fifth crop of rye grass has been cut. The farm is managed by Mr. Cupit, late of the Nottingham Sewage Farm.

In order to test the result of the work, a sample was taken every hour on one day during the recent dry and hot weather. The twenty-four samples were mixed together and sent up for analysis to Mr. Pooley, county analyst, and the following is his Report:—

Copy of Analyst's Report.

A.—Pure Sewage.
B.—Sewage after Chemical Treatment.
C.—Effluent after passing through the land.

	A.	B.	C.
	Grains per imperial gallon.		
Suspended Matter (Mineral	8·05	1·54	1·40
Suspended Matter (Organic	20·54	2·52	0·84
Total Solids in Solutions	58·80	45·50	49·00
Chlorine	8·05	4·76	6·11
Free Ammonia	4·06	2·54	1·05
Albumen Ammonia	0·42	0·21	0·14

I consider the effluent C very good and unobjectionable.

(Signed) THOMAS A. POOLEY, B.Sc., T.I.C., T.C.S.,
County Analyst.

Dated, *Sept.* 23, 1886.

The cost of the machinery was 925*l.* 10*s.*; the concrete carrier, &c., 1400*l.*; the low-level tanks, 750*l.*; and the buildings, 1278*l.* The cost of treating the sewage with chemicals is 16*s.* per million gallons, the total cost being 30*s.* per million gallons, including labour, sundries, pumping low-level sewage, sludge, &c. The quantity to be dealt with daily is 950,000 gallons.

After having inspected the sewage works the visitors walked over the farm, where they had an opportunity of seeing the application of the sewage and the results produced on the crops.

II.—THE EAST LONDON WATERWORKS.

The Members then proceeded to the pumping station of the East London Water Company at Lea Bridge, where, in the absence of Mr. Bryan, the engineer of the company, they were received by Mr. Blackburn, the chief assistant engineer, and by him and Mr. Jeffrey conducted over the Lea Bridge pumping station. Thence the Members proceeded to the new works and pumping station at Chingford Mills. The various visits were thoroughly appreciated, and terminated by the Members dining together at the Forest Hotel, Chingford.

The following account of the East London Waterworks is taken from *Iron.*

The first company supplying East London with water was termed the Shadwell Waterworks, and they commenced operations

in 1669, and obtained their first Act of Parliament in 1691. In 1747 the West Ham Waterworks were established for supplying West Ham, Stratford, and Bow with water, the motive power being a water wheel on a branch of the river Lea at Stratford. These works passed out of the possession of the East London Waterworks Company at Christmas 1883. In 1807 the East London Waterworks Company was incorporated, and in the following year they purchased the Shadwell and West Ham Waterworks. Mr. W. B. Bryan, the engineer of the East London Waterworks Company, to whom we are indebted for these particulars, has in his possession a large number of books from the year 1680, showing contract prices for various stores, hay, straw, wooden pipes, and other materials. The company constructed at Old Ford settling reservoirs, the water from the Lea being then unpolluted. In 1808 two engines called the *Twins* were erected at Old Ford, and these engines are still in existence and in good working order. In 1829 the company purchased the Hackney Waterworks and the Lea Bridge Mills, these being a portion of the site visited by the Association. The company removed their intake from Old Ford to Lea Bridge about the year 1832. The company's intake has been carried higher and higher up the river, and it is now at Ponders End. The water is brought from Ponders End into the reservoirs by means of an open river course, as far as Chingford Mill. From Chingford Mill the high-level reservoirs are filled by means of two parallel brick culverts each 5 feet high and about 2½ miles in length. The low-level reservoirs were formerly filled from the river Lea at Higham Hill, or from the high-level reservoirs, but extensive works are now in progress under the powers conferred by the Act of 1886, which will make the point of intake for the high-level and the low-level reservoirs at the same place. The reservoirs have a water area of about 220 acres, their total capacity being 900 million gallons, 600 million gallons of which will run off by gravitation down the company's aqueduct to the filter beds at Lea Bridge. These filter beds have an area of about 25 acres. In addition to this the company have also 5 acres of filter beds at Hanworth, near Sunbury-on-Thames. The company have powers to take 10 million gallons a day from the Thames. They have a station on the banks of the Thames at Sunbury, and two powerful engines, each capable of lifting 10 million gallons per diem to the filter beds at Hanworth. At Hanworth there is an open reservoir for unfiltered

water, having a capacity of 5 million gallons, and a covered reservoir for filtered water capable of containing 2 million gallons. There are three fine Cornish engines in a large and handsome engine-house. The chimney shaft is 250 feet high, and contains a two-legged standpipe. The water is pumped from Hanworth to a covered reservoir in Finsbury Park, and from this it gravitates into the westerly portion of the company's district. The company have commenced extensive works at Hanworth, for the purpose of obtaining water from underground sources. At the present time the company have three wells in the chalk, one at Chingford, one at Walthamstow, and one at Old Ford. Another well and pumping station have been commenced at Waltham Abbey, from whence it is proposed to lift the water altogether a vertical height of 500 feet to a proposed service reservoir in Epping Forest. Contracts have also been let for other large wells in the valley of the Lea.

The company have nine stations, and contemplate several more. The distance apart of the furthermost will be very nearly 35 miles. The following description of their engines, which are in the aggregate capable of lifting 120 million gallons of water per diem, will give an indication of the magnitude of the company's operations. At the Old Ford station there is a Wicksteed engine, having a steam cylinder 90 inches diameter by 11 feet stroke. Another engine named the *Hercules* has a steam cylinder 86 inches diameter by 10 feet stroke. Then there is a Cornish engine, with a steam cylinder 80 inches diameter by 11 feet stroke; the *Ajax* engine, with a steam cylinder 72 inches diameter by 10 feet stroke; the *Twins* engine (east), with a steam cylinder 36 inches diameter by 8 feet 3 inches stroke; and a *Twins* engine (west), with a steam cylinder 36 inches diameter by 8 feet 3 inches stroke; and, finally, we have a well engine, with a steam cylinder 13 inches diameter and a 2 feet stroke.

At the Lea Bridge station there is, first, the *Victoria* engine, with a steam cylinder 100 inches diameter by 11 feet stroke; then there is the *Prince* engine, with a steam cylinder 84 inches diameter by 11 feet stroke; the *Princess* engine, steam cylinder, 84 inches diameter, 11 feet stroke; the *Duke* compound rotative engine, with cylinders of 23 inches and 39 inches diameter, and 4 feet 5 inches and 6 feet 6 inches stroke respectively; the *Duchess* engine, of the same dimensions as the *Duke*; a horizontal compound tandem engine, with cylinders 23 inches and 40 inches

diameter, and 3 feet stroke; and a vertical engine, with a steam cylinder 13½ inches diameter by 2 feet 3 inches stroke. There are also at Lea Bridge a large and a small undershot water-wheel and two powerful *Hercules* turbines, which are capable of exerting 50 horse-power each. These turbines are run with a 6-foot head of water, and drive four 8-inch double-acting pumps, delivering 13 gallons at each stroke, the turbines running at 30 revolutions per minute and working against 125 feet head of water. Designs are in progress for further engine power of about 250 horse-power at the Lea Bridge station.

At the Walthamstow station the water is pumped from a deep well into the district and into Finsbury Park reservoir, a total lift of about 200 feet, by means of a small turbine, which is capable of exerting 60 horse-power. This turbine is worked by the water passing from the high-level reservoirs to the filter beds. At this station it is contemplated putting down engines of about 500 horse-power. At Chingford Mill there is a well 450 feet deep, and the water is pumped a total height of 340 feet by means of two Girard turbines capable of exerting 36 horse-power each. These turbines work with a head of about 10 feet and drive a special double bucket-pump by Messrs. Mather and Platt, of Manchester, which gives a continuous flow. It is a 16-inch pump, with a 5 feet stroke, working at 6½ strokes per minute. There is also a small compound beam engine at this station. At the Woodford station there are a pair of horizontal engines, each of 60 horse-power. There are two covered reservoirs, each of a capacity of 1½ million gallons. At Buckhurst Hill, there is an elevated tower with a tank, holding 70,000 gallons. The engines at Sunbury are two in number, each with steam cylinders of 54 inches diameter and 9 feet stroke. At Hanworth there are three engines, each with steam cylinders 84 inches diameter and 11 feet stroke. At the Waltham Abbey pumping station the power required will be about 200 horse.

Extensive tunnelling operations at a depth of nearly 200 feet from the surface of the ground will shortly be commenced, powers having been obtained during the past session. The amount of water pumped into the district daily is about 42 million gallons at the present time, and has reached on one occasion as much as 47 million gallons. The population supplied is 1,170,000. All the houses within the metropolitan area receive a constant supply.

DISTRICT MEETING AT WEST HARTLEPOOL.

October 2nd, 1886.

Held in the Commissioners' Board Room, West Hartlepool.

Mr. R. S. Rounthwaite *in the Chair.*

The minutes of the last meeting were read and confirmed.

Mr. P. W. Thomson tendered his resignation as Honorary Secretary for the Northern Counties District, but in compliance with the unanimously expressed wish of the meeting consented to retain office for another twelve months, and was re-elected.

THE CONSTRUCTION AND MAINTENANCE OF MACADAMISED ROADS.

By J. W. Brown, C.E., F.G.S., West Hartlepool.

The construction and maintenance of macadamised roads are subjects which do not perhaps require the application of that amount of scientific knowledge which is necessary in some other branches of a town surveyor's work; nevertheless, much care and no little skill is required in satisfactorily constructing macadamised roads; and equally much, if not more, is required in their maintenance, as is well known to the Members of this Association.

The subject will doubtless be more or less interesting to Members, as the proportional area of their towns are macadamised; in many towns nearly the whole of the streets being paved in some form or other, while in others, of which West Hartlepool is one, nearly the whole of the streets are constructed of this material.

From the time of the Romans to the reign of Henry VIII., but little care appears to have been taken in the construction and repair of roads. In Henry's reign, however, and subsequent to

this, laws were enacted, binding parishes to undertake care of the roads, and to appoint qualified persons to superintend them. Although the various Acts required the appointment of *qualified* persons to exercise supervision over the roads, it appears that such persons were not always appointed, probably owing to the ignorance of those with whom the appointment rested, for farmers and farm-labourers were usually selected for the post, and as may be imagined the existing system of road construction was not very much improved upon. The roads were narrow, badly laid out, badly drained, in many cases without foundation, and inferior materials were used; in short they got from bad to worse, until in 1760 the whole country became indignant, or we may assume it did, as from this date to 1774 numerous Acts were passed for their improvement.

Although considerable progress was subsequently made, the roads in 1819 could not be considered in any way satisfactory, for Mr. J. L. McAdam, in his evidence before a select committee of the House of Commons, stated that "although he was not a professional engineer, the defective condition of the roads could not fail to attract his attention." Mr. McAdam further stated that his attention had been more or less directed to road-making and repairing during the last twenty-five years, and that in 1816 the roads of Bristol were put under his charge. When Mr. McAdam introduced his improved system of road repair, he became very popular, and for a time was much sought after by county and other Boards. Glowing accounts were given by him of the amount of expense which could be saved by the adoption of his system. In his opinion there was no necessity to lay the foundation of a road on any ground, even the most soft and peaty, with large stones; daily observations told him that it was a great waste of time, materials, and money. The only thing to make a good foundation was to lay down a bed of from eight to ten inches of finely broken stone and to keep the ruts raked in until the stone united by its own angles. Mr. McAdam also asserted that the principle of road-making which he thought most valuable, was to put broken stone which should *unite by its own angles*, upon a road, so as to form a solid, hard surface. Therefore it followed, that when material was laid upon the road, it must remain in the situation in which it was placed without ever being moved again. There must be no admixture of binding material, but the stone must be perfectly clean. This rule of McAdam's, which in theory might

appear all right, but which in practice is found absolutely impossible to accomplish, is much cherished by amateur road-makers, who ascribe all the ills that unpaved roads are heir to, to the non-adoption of this rule, and when they spy a hole in the road they assert it would not have occurred had the road been repaired according to McAdam's principles. When roads have become dirty owing to the traffic grinding down the material, they assert that had the material been allowed to *unite by its own angles* instead of adding binding material when the road was repaired, a perfectly clean road would have been the result; and the like of course with the dust. In fact, a beautiful mosaic pavement would adorn all our streets, which, in the language of Mr. McAdam, would be perfectly unaffected by the weather. No wonder then that the general rate-payer, who has no knowledge of the subject, should get somewhat mixed, and be ready to exclaim, "The whole concern is improperly managed."

Would it not be refreshing for Members of this Association to see a macadamised road perfectly unaffected by the weather? The picture is too delusive.

In the *first* place it would be simply impossible to construct a satisfactory road for the use of ordinary traffic over boggy or peaty ground without the aid of some material other than 10 inches in depth of finely broken stone. In many cases the whole of the material would be pushed out of sight in a few days, and where this did not take place, the stone would be so intermixed with the soil, that the ideal road formed of perfectly clean stones "united by their own angles," as required by Mr. McAdam, could not by any possible means be obtained. In the *second* place, when the surface of a road is repaired by adding new material, one of three things must take place, notwithstanding what Mr. McAdam says; no matter whether the material is consolidated by the aid of a steam or other roller, or is left to be consolidated by the ordinary vehicular traffic, assisted by the rake, either a sufficient quantity of binding material must be added in the first instance, the material itself must be deteriorated by rolling, or by the traffic, until the interstices are filled, or the consolidation of the material must continue until from the old surface a sufficient quantity of pulverised material has been forced up by displacement in the operation of consolidation. It would seem more reasonable to add the necessary binding material in the first instance, than to provide it at the cost of the excessive deteriorating of the broken stone, both

from a point of cleanliness and economy—economy, because the material used for binding only costs about 1*s.* per load, whereas the broken stone will cost from 8*s.* to 9*s.*; cleanliness, because by adding the "binding," the broken stone is not so much pulverised, and in consequence wears much longer and cleaner.

Mr. G. F. Deacon, C.E., late City Engineer, of Liverpool, had doubtless been troubled with some of the followers of McAdam, when he allowed himself to be induced to try the experiment of consolidating broken road stone without the aid of "binding." In vol. lviii. 'Proceedings of Civil Engineers,' p. 18, he stated that under a 15-ton steam roller, preceded by a water-cart, 1200 yards of trap-rock macadam, without binding, could only be moderately consolidated by twenty-seven hours' continuous rolling; if blinded with hard rock chippings from a stone breaker, the same area might be moderately consolidated by the same roller in eighteen hours; if blinded with silicious gravel from $\frac{3}{4}$ inch to the size of a pin's head, mixed with about one-fourth part of macadam sweepings, the area might be thoroughly consolidated in nine hours. He further stated that macadam laid according to the last method wears better than that laid by the second, and that laid by the second much better than that laid by the first.

The *Westminster Review*, vol. iv. p. 354, observes that "the name of Mr. McAdam deserves a few remarks for other reasons than its present popularity. The public naturally looks to him as a sort of magician, and his invention, as it is thought, as something preternatural. If his own name had not been macadamisable into a verb, it is probable that his roads would have been little known. He did not invent the method in question of breaking stone, because it had long been the practice of Sweden, Switzerland, and other countries, and was long known to every observing traveller. Although what is commonly called Mr. McAdam's system of road-making, had nothing original in it, and was in all its essential points not only not according to the principles of science, but directly opposed to them, still he certainly had the merit, of no inconsiderable value, of being the first person who succeeded in persuading the trustees of turnpike roads to set seriously about the improvement of them."

Doubtless much credit is due to McAdam for the indomitable perseverance shown in bringing about an improvement in the method then adopted of repairing roads. The system advocated then, however, would not be tolerated now; nor do I think many

engineers would care to risk their reputation by trying to carry out rules so impracticable. About the same time McAdam was so busy propounding his system of road making and repairing, another person, Mr. Telford was equally busy constructing roads in Scotland, but on an entirely different system. Mr. Telford did not believe it possible to construct a perfectly hard road by simply depositing 10 inches of finely broken stone upon a soft peaty foundation, nor did he (like McAdam) hold that it was necessary in the construction of a road to obtain an elastic foundation, but, on the contrary, he believed that one of the most important things in connection with the construction of a road was to obtain, wherever possible, a perfectly hard, dry, and non-elastic foundation. His general practice was, if the line of road was found at all soft or wet, to thoroughly drain the site of the road, after which a bed of rough stones from 6 to 8 inches deep was laid by hand compactly together and the interstices filled in with small pieces, and upon this was spread a layer of stone broken so that the largest piece would pass through a ring $2\frac{1}{2}$ inches in diameter, 6 inches in depth, and covered with 1 inch of fine gravel for binding purposes. McAdam tried to show that by adopting a non-elastic foundation, as suggested by Telford, the broken stone used for top covering would be considerably damaged by the wheels passing over it, while in his system of constructing roads without foundations, the roads would yield with the pressure and so save the stone from being crushed.

This argument appears all right in theory, but in practice it is found not to hold good, it having been abundantly proved that one of the most essential elements in the economical maintenance of a road either paved or macadamised, is to have a perfectly hard and non-elastic foundation. Sir John Macniel states that where there is a yielding and elasticity in the road, there must be motion among the particles with which the road is formed, and this motion produces wear. The wear Sir John refers to is much increased by the moisture from the surface finding its way into the foundation each movement of the particles, the water causing a complete scour between the several pieces of stone forming the surface of the road, as well as loosening and softening the foundation.

It is said by Mr. H. R. Reynolds, who wrote an article on the wastefulness and inefficiency of road repairs, which appeared in the *National Review* for September 1885, "that as a rule the surface of the roads of the British Isles are far inferior now to what they

were in the coaching days." That where there used to be a hard, smooth, convex surface, free equally from ruts and holes, from dust and mud, and needing but very slight repairs, there is now generally, to be found a road full of holes and puddles, ruts and ridges, covered with deep mud in wet weather, or with dust and loose material during a dry season. Mr. Reynolds doubtless has, when travelling along the country lanes on his bicycle, experienced some rough riding, and in consequence has given some little attention to the subject of road repair. When passing along it would appear that Mr. Reynolds tried to strengthen his own convictions (founded on theory) by dismounting when he observed a labourer at work on the roads, and subjecting him to a string of questions, and if the replies agreed with his own ideas, doubtless he would, on the evidence of the labourer, make an entry against the highway surveyor. This mode of obtaining information to be used against the surveyor is as gentlemanly as the information thus obtained is calculated to be accurate. I deny the assertion that as a rule our roads are in a worse condition now than in the coaching days, notwithstanding all that Mr. Reynolds has to say. Some of the main lines formerly used by the coaches are, we all know, somewhat worse than they were when the coaches ran; but as a rule, however, the principal lines of traffic are in a much better condition than what they were then, and the roads constructed since that time have been constructed and are maintained in a far superior manner.

In nearly all cases the writers of the coaching days condemned the roads, and some of them in language more forcible than polite.

Before bidding farewell to Mr. Reynolds, I should like to examine a few of the assertions made in his paper. It is, however, so full of misleading statements and exaggerations, that one scarcely knows where to start; nor would it have been worth the trouble, had not the *Times* and other papers devoted some little time in confirming, in some measure, his contentions; and were they not just the right kind of food for the troublesome amateur, with whom we all have to do, more or less.

To begin with, then, Mr. Reynolds states that 1 cube yard of stone broken to an inch and a half will cover from 40 to 50 square yards on surface of road, but if broken to 4 inches it will cover but six or eight, and as three-quarters of an inch of consolidated road is admitted to be as much as a highway usually loses in thickness in a year, even under heavy traffic, it is evident that to put down a greater thickness of stone every year is mere waste of material.

Yet it is the exception rather than the rule, to find road metal laid down which does not average $3\frac{1}{2}$ inches, or more than treble the size, and the loss to the ratepayers from this cause alone may be reckoned at millions annually!

It would be interesting to know how Mr. Reynolds can make 1 cube yard of stone broken to $1\frac{1}{2}$ inches, cover from 40 to 50 square yards, as when the covering capacity of the stone is increased by being broken to 1 inch, 1 cube yard can only cover before consolidation 36 square yards, and after consolidation not more than about 27 square yards. Again, how is it that when the stone is broken to $3\frac{1}{2}$ inches, it will only cover from 6 to 8 square yards? One cube yard of broken stone will cover 10 square yards $3\frac{1}{2}$ inches in depth before consolidation. And, if the surveyor places on his roads a covering $3\frac{1}{2}$ inches in depth each year (as implied by Mr. Reynolds), and traffic of the heaviest description does not wear down more than three-quarters of an inch, the depth of the material on the road is increased in thickness by $2\frac{3}{4}$ inches each year, and this having been continued since the time of the coaching days, say roughly sixty years, we have on the roads in the kingdom, independent of the original foundation, no less than 13 feet 9 inches!

I have seen several roads, and some very old ones, broken up, but never observed a depth of material approaching 13 feet 9 inches.

Further, Mr. Reynolds uses the arguments of McAdam, and demands that the broken stone, when laid on the road, shall be made to unite by the virtue of their own angles, and that no binding material shall be spread to fill in the interstices.

He states there is no point on which greater ignorance, stupidity, and wastefulness are exhibited than in the repair of roads. I am prepared to admit there is no point on which greater ignorance is exhibited by some, but the ignorance is fortunately confined principally to such as Mr. Reynolds.

It would be a most sorry sight to see a highway surveyor who exhibited more ignorance in the maintenance of the roads under his care, than is displayed by the writer of the article on the "Wastefulness and Inefficiency of Road Repair," which appeared in the *National Review* for September 1885, in the subject with which he attempts to deal.

As a bicyclist Mr. Reynolds may excel, but as a leader in road repair he has failed ignominiously.

The method principally adopted in the construction of streets and roads at the present time is to excavate or fill in the ground to the required levels longitudinally and transversely, taking care to provide for the foundation being properly drained, either by rubble or other suitable drains. To thoroughly consolidate the ground by ramming, upon which a bed of slag or rubble broken to a 3-inch ring is spread to such depth that when thoroughly consolidated either by the steam or horse roller it shall measure not less than 8 inches, and upon this is spread whinstone broken to a 2½-inch ring, to such a depth that when thoroughly consolidated by the steam roller it shall measure not less than 4 inches in depth. The depth of both slag and whinstone of course vary in the various towns and counties. In the North the foundation of the roads is often formed after Telford's method, by pitching the bottom with slag or other suitable material with pieces from 6 to 8 inches in depth, packed closely together by hand, and the interstices filled in with small pieces. Although the latter system is advocated by some, it is generally admitted, at any rate for town roads, that it is better to use material broken as before described. In each case, of course, the top layer is finished in the same manner.

Concrete undoubtedly makes the best foundation either for paved or macadam roads, but its cost precludes its use for macadam, although it is usually adopted for the foundation of pavements. Some diversity of opinion exists as to the correct method of repairing roads, some holding that before applying any new material to the surface of a road, no matter how much worn, the whole surface should be chequered or loosened so as to enable the new material to incorporate with the old; they also holding that by the entire surface being loosened, the act of consolidation by the roll does not injure the stone so much as when the road is not chequered, the loose material forming a kind of cushion for the new. Moreover, a less quantity of binding material suffices, when the road has been loosened, as when the new material is being consolidated the old is displaced, and so forced up into the interstices of the new layer. Others hold that it is a waste of labour to chequer the whole surface, more particularly when the road has become considerably worn and weak; the old surface being well watered is deemed to be sufficient to soften the surface so as to admit of the new material being incorporated with the old without material injury.

The former of the two systems appears to me to be the most reasonable, and has been practised by me for many years.

The stone principally used in the North for repairing macadam roads is a basaltic rock obtained from Great Ayton, Cockfield, and other places along the North of England dykes. The composition of the Great Ayton stone is given in the 'Quarterly Journal of the Geological Society' for May 1884 as

Silica	57·57
Alumina	14·25
Ferric oxide	6·04
Ferrous ,,	3·95
Manganese oxide	·27
Lime	6·87
Magnesia	4·24
Potash	1·08
Soda	2·98
Sulphur	·19
Carbonic acid	·30
Phosphoric ,,	·15
Water	1·25
	99·14

Its specific gravity is about 2·7.

A similar stone to this both in composition and specific gravity is found at Rowley Regis, and is locally known as "Rowley Rag"; it is largely used in Birmingham and the neighbouring towns. In Leicestershire and Nottinghamshire the road stone is largely supplied from the Leicestershire Syenitic Granite Quarries, from the Mountsorrel Quarry Company, Loughborough, Bardon Hill, &c. This syenitic granite is considered by many to be a superior stone for road construction to the true granite. In many Yorkshire and Lancashire towns limestone is used; it cannot, however, in any way be considered equal either to the granite or basalt for road work; its power of resistance to a crushing force is much less, as well as its being very sensitive to atmospheric changes. Probably the principal reason of its general use is its cheapness in first cost. The limestone referred to is largely obtained from Skipton and Clithero.

Much controversy has taken place from time to time with respect to the most suitable size to which road stone should be broken. McAdam insisted that the stone should be broken to such a size that the largest piece would not weigh more than 6 ounces, and

to enforce this his assistants had to carry with them a pair of scales for the purpose of testing the stonebreaker's work.

Mr. Telford specified that the stone should be broken to such a size that the largest piece should pass through a ring $2\frac{1}{2}$ inches in diameter, while others less noted in the construction and maintenance of roads insist upon the stone being broken to $1\frac{1}{2}$-inch ring, and some even to 1 inch.

Mr. Ellice-Clark, in his paper read before the Cyclists' Society, on the maintenance of suburban and rural roadways, recommended that granite should be broken to an approximation of from $3\frac{1}{2}$ ounces to $\frac{1}{2}$ ounce per stone; flints 5 ounces to $\frac{3}{4}$ ounce; limestone 6 ounces to 1 ounce.

The method of testing the size of the stone as well as the size to which they are broken which has found most general favour with surveyors, is that recommended by Mr. Telford; the size practically agrees with that given by Mr. McAdam, inasmuch as a stone taken at random from the heap which will just pass through a ring $2\frac{1}{2}$ inches in diameter, in its greatest dimensions, is found by practice to weigh about 6 ounces. This being so, it is found much more convenient to train the men to gauge the stones by the ring than to weigh them.

If the stone be broken to such a size that the largest piece will not weigh more than $3\frac{1}{2}$ ounces, a very large proportion will be found utterly useless to withstand the pressure of the ordinary traffic, and with heavy traffic will speedily be reduced to mud. If it be necessary to break the granite small, so as to reduce the interspaces, why should it not be equally necessary to break limestone small for the same purpose.

A very important part is played by the binding material used in the construction and maintenance of macadam roads, and unfortunately for us in the North, a suitable material is difficult of access. The material largely used for this purpose is selected road scrapings, and in some cases doubtless answers well; but in others the scrapings are of such a composition as to render them most unsuitable for the purpose. However, in the neighbourhood of the Hartlepools no other material can be obtained except at very high prices, and the roads suffer accordingly. The material which appears most suitable for this purpose is a fine pit gravel of a rather loamy nature, but as free as possible from lime. This material does not after every shower of rain adhere to the cart-wheels, so as to disturb the whole surface of the road, nor have I ever seen it affected in this

manner to any extent except at the breaking up for a frost, a time when everything movable on a road is moved. Unfortunately for us at the Hartlepools, the materials accessible for binding purposes are full of either clay or lime, and in consequence the whole surface of the macadam traversed is disturbed every shower of rain. No sooner has the surface become hard and fairly even than the top layer is again misplaced, and by this process the broken stone forming the top layer of the road is much more rapidly ground up into mud than would be the case if the stone remained at rest. The best substitute known to the author, in this district, for the ordinary binding material is pitch and tar used with the broken stone as tar macadam. This mixture has been largely used in Leicester and other towns, and has the virtue, when properly prepared, of being of such an elastic nature as not to be materially affected by the vibration of the traffic. It holds the several pieces of stone of which the road is formed, firmly in position, and so reduces the wear to a minimum; moreover, it is non-absorbent, and prevents the water percolating into the foundation.

Although a trial of this has been recommended by the author, it does not appear to find much favour as yet.

Much nonsense has been talked and written about McAdam being able to cause perfectly clean broken stone to unite by its own angles and so form a perfectly clean, hard, smooth surface, and one perfectly unaffected by the weather.

I think Members of this Association will agree with me when I say that neither McAdam nor any of his followers were ever capable of accomplishing this feat. It is not an easy matter to make concrete blocks in the absence of cementitious matter; nevertheless, it is quite as easy to accomplish this, as it is to make perfectly hard, clean stone unite by virtue of its own angles in its ordinary application to road construction and maintenance.

HARTLEPOOL HEADLAND PROTECTION.

By HUGH MAIR, C.E., Borough Surveyor, Hartlepool.

Construction of Sea Wall.

The town of Hartlepool, from having been originally a small fishing village, has risen to be a port of considerable importance. From Sir Cuthbert Sharp's History of Hartlepool, it appears to have been the only port town in the county. The first charter of incorporation was granted by King John in the year 1200: it thus ranks as one of the oldest corporations. The boundaries of the ancient borough were extended in 1883 by the inclusion of the districts of Throston and Middleton, and the municipal area now is 547 acres, the population at the last census being 17,000.

Although the dock system of West Hartlepool is the centre of the greatest commercial activity, there can be no doubt that the flourishing condition of the port is to be attributed to the geographical position of Hartlepool, and to the improvements made in the tidal harbour. The natural channel which formerly led to the Slake has been so deepened that the North-Eastern Railway Company, in designing their large area of docks, kept in view the advantage of retaining the deep-water channel at Hartlepool; the other entrance for vessels of lighter draught being at West Hartlepool.

I have detailed these particulars somewhat, so as to make clear the importance of protecting what is the deep-water entrance to the large system of docks. As will be seen by a reference to the plan, the town is built on a promontory of peninsular shape extending into the sea for nearly three-quarters of a mile beyond the general coast line north and south, and forms what is called the "Heugh"; it therefore protects the harbour from the northerly and north-easterly gales.

The question of forming a harbour of refuge to the south has long been talked of, and in 1854 Mr. J. M. Rendell, the engineer, reported, at the request of the Admiralty, favourably upon the scheme; he also reported that "the importance of securing the 'Heugh' from further waste and reduction of the shelter it affords

no less to the bay than to the town and docks, is such that I think the proper time has arrived for building a sea wall around it, from the pier northwards to where the high cliffs lose themselves in the sandhills: this is not now a difficult or as compared with its importance an expensive operation."

The question of headland protection has therefore been before the public of Hartlepool for something over thirty years; the difference of opinion has not been as to the necessity for carrying out the work, but as to who should pay for it.

Up to the year 1833 the Hartlepool Corporation were entitled to receive for every decked vessel entering the harbour the sum of 1*s.* 4*d.*, and for undecked vessels the sum of 4*d.*; with the proceeds of these tolls the town walls were maintained. As the Corporation in that year fell into abeyance, the Port and Harbour Commissioners were empowered to demand for every decked vessel which entered the harbour one-fourth and for any vessel entering the harbour other than for the purpose of loading or unloading, any sum not exceeding one-half of the before-mentioned sum.

Up to the year 1855 the Corporation and Port and Harbour Commissioners at different times and by different Acts collected these tolls, and with the proceeds repaired the town walls, and should have protected the headland from the inroads of the sea. Whenever the tolls were collected by the Corporation or by the Commissioners, the responsibility of protecting the headland always attached to the party in whose hands they were from time to time vested. In this year the Commissioners promoted a Bill empowering them to construct certain new works, viz.—

"1. An outer harbour of refuge in the bay of Hartlepool.

2. A southern pier or breakwater.

3. A northern pier or breakwater.

4. Sea walls or barriers and all requisite and proper works and conveniences connected therewith, for the protection of the headland of Hartlepool, and the cliffs near or adjoining thereto, from the inroads of the sea, such sea walls or barriers to commence from a point near the far lime-kiln, thence along, opposite, or near to the course of the cliffs up to and terminating at the commencement of the northern pier. Provided always that the Commissioners shall not be bound to make the works fourthly specified further northward than the northern extremity of the point of limit on which the present lighthouse *stands until they had completed the other works by this Act authorised.*"

The responsibility therefore of protecting the headland from the commencement of the northern pier to the lighthouse was thrown upon the Commissioners, and which work has now been done; but they need not protect further northward than the lighthouse until they had completed the other works authorised. No time being thus limited for the completion of the works, and as they were of an extensive character, the prospect of protecting the headland between the lighthouse and Corporation road was not ever likely to happen.

From time to time subsequent to the year 1855, when the deferred responsibility of the Commissioners was undertaken to protect the headland up to the year 1881, various plans and proposals were made by the Corporation and Commissioners that the work should be proceeded with, but no practical result attended these efforts until the year 1881. Advantage was taken of a visit in that year, to the town, of the Right Hon. Joseph Chamberlain, M.P., President of the Board of Trade, when the matter was laid before him, and he agreed to arbitrate in the matter. His award was published in the year 1882, and contained amongst other clauses one to the effect that a joint committee of the Corporation and Commissioners be appointed, two-thirds to be elected by the Corporation, and one-third by the Commissioners, to carry out the award, and that the payment should be made in the proportion of two-thirds by the Corporation and one-third by the Commissioners. The award was accepted, and in 1884 the joint committee met and requested the Consulting Engineer to the Commissioners and myself to prepare plans for protecting the headland in accordance with the provisions of the award of Mr. Chamberlain. Ultimately it was agreed between the two bodies that the plans and designs which I had prepared be accepted, the estimated cost being 22,000*l.* The Bill was thereafter promoted by the Corporation in the parliamentary session of 1885, and the Act received the Royal Assent in August of the same year. The drawings were prepared, and a contract was entered into in January of 1886 with Mr. T. A. Matthews, of Bolton, to execute the work for the sum of 23,319*l.* This is slightly in excess of the estimate, but is owing to the original plans having been extended.

Aspect of the Cliffs.

The headland is composed of magnesian limestone, and on exposure to the action of the sea, heavy rains and frost, easily crumbles away. From an old plan of the town, published about

the year 1816, I find that over 13 acres has been worn away during the last seventy years. Sir Cuthbert Sharp says, in his History published in that year, "that the rocks at Hartlepool, which have been characterised by various writers as 'frightful' and 'pleasing,' are rendered cavernous by the continued action of the waves; they do not in any part exceed 40 feet in height; several detached masses have been formed by the causes stated, into columns and arches of the rudest and most fantastic appearance." These columns and arches have continued to be formed in the same fantastic manner as the older ones were washed, and no doubt the cliff of to-day pretty well represents what was seen in 1816. A ridge of rocks along the foreshore near low-water mark existed up to the year 1832, which tended to break the force of the waves before they impinged upon the cliffs; but about this time a company was formed to construct the Victoria Dock, and they were allowed to remove these rocks for the purpose of using the stone in building the dock walls. The progress of the sea since these rocks were removed has undoubtedly been much more rapid.

Description of Wall.

The wall commences at the east end of Corporation Road, and terminates at the lighthouse, being a total length of 3400 feet; it is as near as possible a uniform line, and is designed to avoid the irregularities of the coast and to prevent the waves concentrating their violence on any one point. From the lighthouse to the north end of the Moor the beach level is lower, and as the ridge of rocks at low water extends seaward for a short distance it causes a large body of water to strike against the wall, and the force of the sea is consequently greater; the section of the wall has therefore been increased, and in addition it is intended to have an apron of concrete to protect the foundation. In the northern half of the wall the ridge of rocks is more seaward, and the level of the beach is higher, and the force of the heavy waves is considerably spent before they reach the wall; the section is therefore reduced; where the cliffs are cut away the rock will be faced with one thickness of concrete blocks, and the interstices between the blocks and the rock filled in with loose concrete. The height of the wall is 17 feet 8 inches above high-water mark of ordinary spring tides; and to prevent as far as possible the spray washing over, the coping course of blocks will be slightly nosed. A railing, consisting

of cast-iron stanchions 5 feet apart, and wrought-iron tubing for the rails, will be fixed in the coping to protect the public. The wall constructed on this line will enable the Corporation to reclaim over 3 acres of land, and it is intended to form a promenade, which will be asphalted the whole length, to vary in width as the face of the cliff recedes or projects, but the narrowest width will be 15 feet. The face of the remaining portion of the cliff between the promenade and the top will be dressed off and benched so as to prevent soil or stones falling on to the asphalte. The top of the wall is uniformly 25 feet above Ordnance datum, and the Moor level or natural surface of the ground varies in height above this level from 6 to 15 feet. The batter of the wall in the first 10 feet from the top is 1 in 20, and for 7 feet 1 in 4, and from this point to the foundation 1 in 8.

Access to the promenade will be had by means of sloping roadways, of which there will be four at convenient intervals, also two additional slopes from the level of the promenade on to the foreshore. The whole of the wall is faced with concrete blocks, but it is to be built to high water of ordinary spring tides with blocks front and back, the space between the two being filled in with loose concrete. Buttresses 6 feet by 4 feet are placed 20 feet apart from centre to centre. The face blocks are mixed in the proportion of 5 to 1, viz. 3 parts of broken stone, 1 part of fine gravel free from sand, 1 part of clean sand to 1 part of cement; the back blocks and loose concrete being mixed in the proportion of 6 to 1.

The standard specification for cement on the works is that the weight is to be 112 lbs. per imperial striked bushel, and ground so fine that the whole will pass through a sieve of 2500 meshes per square inch and not leave more than 10 per cent. residue; that it shall be capable of maintaining on test briquettes of a sectional area of one square inch, a breaking weight of 400 lbs. after such briquettes shall have been immersed in water for a period of seven days; that after having been made into pats and submitted to moist heat and warm water at an even regulated temperature of 110° Fahr. for twenty-four hours, are not to show any signs of blowing.

The concrete is mixed by one of Carey and Latham's patent mixers; the cylinder for delivering the concrete is fixed at right angles to the rails, and the boxes for the blocks are placed at the side, so that when the rails are laid and the material is regularly brought up, no time is lost. The number of blocks put out in

favourable weather is about 50 or over 100 cubic yards per day. The cost of the wall exclusive of filling up the back is about 5*l.* per lineal foot, and the contractor has the sea risk. Three years has been allowed the contractor in which to complete the work.

Near to the Heugh battery, where a large area of land is reclaimed, it has been suggested that a sea-water swimming-bath should be constructed, as owing to the level the water could be renewed each tide at a trifling cost, but this has not yet received the sanction of the Corporation.

I have thus given you briefly a history and description of a sea wall that has formed the theme of many a long discussion, without referring to similar works constructed in other seaport towns; but it is expected that it will form, when completed, a marine promenade equal to any in the country, and be the means of adding Hartlepool to the list of fashionable watering-places on the East coast.

DISCUSSION.

Mr. Brown: I shall be exceedingly pleased if any of the Members who have a wider experience than I have, will throw out any hints as to how we can improve macadamised roads. I am most desirous of adopting in the future the best process, and as so much nonsense has been spoken and written by many different people—not only in this district, but throughout the country—I shall be exceedingly glad if those who have had great experience, will state some of it here. Any amount of criticism will be thankfully received.

Mr. Stainthorpe: I should just like to ask Mr. Brown one or two questions. I notice that he has not touched on the important question of machine *versus* hand-broken stones. I should like his opinion on that question. In the next place he refers to this pitch and tar joining process. I should like to know if they have tried it in Hartlepool, and if so, with what degree of success; also the cost per superficial yard. As far as the remainder of the paper goes, so far as I am concerned, I can only say that I am at one with him. It is a very able paper, and I agree with most of the remarks contained in it.

Mr. Howcroft: I notice that Mr. Brown treats mainly town roads. Stones of the size he has mentioned, I am afraid would take a long time to fasten in the highways. Speaking for myself, I must say that in my district where there is only moderate traffic it would take some considerable time to get the 2½-inch stones in. The gauge to which we break our stones is 2 inches. With reference to the question of machine *versus* hand-broken stones, I think those broken by hand to be decidedly preferable. I would ask Mr. Brown, what is his idea with reference to the steam roller, and further on what depth of metal on the road would he think the steam roller should be used?

The Chairman: Will the author tell us, with regard to West Hartlepool only, what length of macadamised roads he has, and what is the average annual cost of maintaining them, exclusive of scavenging. Perhaps Mr. Brown will also tell us who this Mr. Reynolds is, and whether he is an authority upon the subject. There are always abroad amateur roadmakers, who will try to write us down, and tell us we do not know our business. It is best to let them write.

Mr. Witts: The author refers to pitch and tar binding, of which I should be glad of further particulars. With regard to Mr. McAdam's theory of stones uniting by their own angles, I may say that I have a large district, including about 40 miles of Highways, and I find that unless I use some binding material that has more or less of clay in it, the roads are no good whatever; our traffic not being sufficient to consolidate the metal in a reasonable time.

Mr. Brown replied. He said he was in favour of hand-broken stone, certain qualities of which could not be approached by machine-broken stone. He thought steam-rollers to be a great advantage both in towns and in country. Mr. Reynolds wrote first of all a long letter to the *Newcastle Chronicle*, and upon it the editor wrote a leading article. Afterwards he wrote another long letter—this time to the *National Review* for September 1885. It was a very long article, and upon it the *Times* thought well (to confirm his assertions) to have a leading article. The surveyor to the vestry at Chelsea had some correspondence with him, and altogether it occupied a very great deal of public attention. That was his apology for referring to Mr. Reynolds' letter, but he would not recognise him as an authority. It was solely because the *Times* and *Newcastle Chronicle* devoted leading articles to his letters that he noticed him. These were papers of influence, and he thought he should not be out of place if he referred to him in his paper. He knew that Mr. Reynolds was a great bicyclist. The papers having devoted some little attention, he may seem to be an authority in consequence.

Information relating to West Hartlepool municipal works having been given, the discussion closed.

The Hon. Secretary proposed a vote of thanks to Mr. Brown for his paper on the "Construction and Maintenance of Macadamised Roads," and to Mr. Mair for his paper on "Sea-wall Construction." The motion having been seconded,

The Chairman said: I should just like to say a word in support of the proposition. To Mr. Mair we are much indebted for his interesting paper. Especially, however, are we indebted to him for the view of the work we have had this afternoon. We cannot but express great satisfaction with the work Mr. Mair is carrying out along the foreshore. It is a satisfactory, and, I am sure, a very cheap job, and I am really surprised at the progress that has been made with the wall. Mr. Mair tells us that 200 blocks have

been laid down in two months. It seems very extraordinary to me that he should get a contractor to do the work with such despatch.

The motion was then carried.

The Members travelled by tram to the east terminus of the line of rails where the Messrs. Treckmann's Cement Works are situated. The active manager (Dr. Treckmann) met the Members at the entrance, and by him they were shown a process, easy in theory, but difficult in practice. There is much machinery in the works, and no less than three kinds of furnaces were in use on the occasion of the visit. The Members were hospitably entertained by Dr. Treckmann.

The Hartlepool Headland Works were inspected with evident pleasure by the company, which was then under the guidance of Mr. Mair, the Borough Surveyor, who, with Mr. Matthews, the contractor, described the work, in connection with which much information is given in the second paper.

DISTRICT MEETING AT WARRINGTON.

November 27th, 1886.

Held in the Council Chamber of the Town Hall, Warrington.

Mr. J. Lobley, *President, in the Chair.*

Alderman Harrison referred to the illness of the Mayor of Warrington, explaining the circumstances under which it took place, and proceeded, on behalf of the mayor, to give to the Members of the Association a hearty welcome to Warrington. He said:—You are all representatives of an important branch of science, which involves not only the comfort of the people, but the life and health of the nation, therefore we should warmly welcome you here. I do, in the name of the mayor, most sincerely welcome you, and I hope that the meeting which will be held will be productive of that benefit and mutual advantage which will ultimately guide you in the course you are now pursuing—the development as much as possible of the advantages of sanitary science. As a Warrington man I am proud to say we have taken a place almost unique in sanitary science. We have not been niggardly in spending our money for the purpose of solving the problem how to get rid of town refuse, and I think we have succeeded in getting rid of it, and that we have one of the most perfect systems ever adopted, which I hope you will have the opportunity of seeing to-day.

Mr. S. S. Platt, A.M.I.C.E., Borough Surveyor of Rochdale, was unanimously re-elected Honorary Secretary.

The minutes of the last meeting, held at Blackburn on the 28th of August, 1885, were confirmed.

THE PUBLIC HEALTH ACT, 1875,—THE 150TH SECTION. — SUPPLEMENTAL REMARKS ON ITS OPERATION, WITH SUGGESTED REMEDIES OF ITS DEFECTS.

By W. SPINKS, Assoc. M. Inst. C.E.,
Surveyor to the Local Board of Dukinfield, Cheshire.

This paper will be found in the Proceedings at Rochester Meeting, see p. 8 of this volume.

Mr. Spinks then read his paper.

Alderman Davies: I rise to move a vote of thanks to Mr. Spinks for the very admirable and useful paper that he has read to the meeting to-day. I hope that it is not out of order for me, not being one of your body, to move a vote of thanks, but I am anxious at an early stage to express my thanks, and also my great satisfaction in hearing what my young townsman has so ably read to us, for Mr. Spinks was formerly in the offices of the Corporation of Warrington, and was under the tuition of Mr. Vawser. I think that Mr. Vawser must be proud of his pupil. After hearing what he has just read, as the Chairman of the Paving and Sewerage Committee of Warrington, I have just marked down one or two points, with the view of suggesting discussion, which I shall be very glad to hear. The first thing that presented itself to me was a remark about minor streets. Mr. Spinks said "for minor streets, which are not thoroughfares, are only residential streets and not main arteries of traffic; a local sett is used in paving, the foundation is macadam on rock pitching. In streets of the first class granite paving is laid, and all joints are asphalted." You can well understand that the Paving and Sewerage Committee of Warrington, and no doubt of the various Local Boards and Corporations, would like to have an expression of opinion at a meeting like this, as to what the experience of the members was as to the nature and quality of the streets that were made, such as *culs-de-sac*, or residential streets. I shall be very glad to hear an expression of opinion on that point, for the benefit of the Corporation. The next paragraph was about the fourth line under the heading of

"Premises," and on this point a vexed question had arisen in my own experience. The paper said, "A railway or canal running parallel to and adjoining a street are liable, as also a railway crossing over a street, but where a road was carried over the railway, it was decided that neither the railway underneath, nor the slopes of the cutting, could be said to abut on to the road, nor even of the parapet of the bridge." According to the reading of the present law, the railway was liable. I know an adjoining town where there is a length of two or three hundred yards of a railway in a cutting, and there is a street running parallel under the authority of a Corporation. That street is in the most deplorable condition—I should think a foot deep in mud—and that street ran parallel with the railway on one side, and was partially built with houses on the other side. The railway company denied their liability. That is rather at variance with what was expressed in the paper. That railway line is near a station, and I am inclined to agree with the paper that the railway company should be liable to make that street. Mr. Spinks, referring to partial works, also said, "It appears that separate works can be carried out, but they must be apportioned upon the whole of the owners, it being invalid if divided up into sections, according to a ruling under the Metropolis Management Acts; but in a case decided under this Act, it was held that the apportionment on the particular owners affected was right." I think that it is quite right that when partial works are executed in every part of the street, the work should be apportioned on the whole of the parties in that street. It had been rather a vexed question for some time, but I agree with the writer of the paper. I am very pleased indeed to hear the paper read by Mr. Spinks, who had been honest enough to give all the praise that he could to those who had assisted him. I myself have had a little experience of divisions of authority in parishes, for, when I went home this day, passing from the lodge to the house, I had to pass through three townships, three parishes and two counties, one twice over. He then formally moved the resolution of thanks to Mr. Spinks.

The proposition was then carried by acclamation.

Mr. THORBURN: With reference to the paving of back streets, I think there is scarcely an officer of a Corporation present but will acknowledge that it is not necessary to go to the same extent with back streets as public thoroughfares. The next question was the liability of railways. I will give a little of my own experience

about that. I believe myself—and I think I have seen and heard it acknowledged—that railway companies were just as liable to pay the cost of sewering and making a street as any one else. In 1881 the Corporation of Birkenhead applied for a new Act. Under the old acts, if a street was in a certain condition, they would proceed to do all that was necessary, and send in the bill without notice. That was the old-fashioned style. When they went in for the new Act they wanted to get as much of the old laws as they could, but they had two powerful railway companies against them, and, at the last moment, with a view of getting certain works done before the provisions of the new Act, the railway companies took advantage of the position they were in. In Birkenhead they wanted to get certain works done at the cost of owners before incorporation came in force, and they (the railway companies) took advantage of the position of the Parliamentary Committee, who gave way to the pressure of the railway people, and had now a clause in their Act of Parliament, that where a street abutted upon a railway, so long as the land was used for railway purposes, the Corporation could not do a single thing at their cost. The railway companies took this opportunity of getting out of their liability, and the clause had on many occasions proved a very awkward one—one that they could not deal with, and one that to some extent they had to suffer from. In regard to the cost of partial works my practice has been to make a survey of a street, get all the particulars, the names of the owners, &c., before moving a step towards putting the Act in force. I then make an apportionment, and invariably dealt with the footways *per se*. The footway of each street was charged each man to his frontage, and the carriage-way was treated according to proportion. If a street varied in width that must be considered. Then there was the question of instalments. Property, as all know, is, in manufacturing towns owned by, comparatively speaking, poor people. Very likely some man with limited means had saved a little money, had invested it in property, and when he died it was left to his widow. Probably a man lived upon a few cottages. We cannot expect a man in that position to pay much for sewering and making a street. In such cases it was the habit of the Corporation I serve to spread the payment over some five years. It is a very common thing for streets to be in two districts, but I am not aware that there is any Act of Parliament that deals with that matter. The work could only be done by agreement, and it is so

done in London. As regarded the paper, I think it contains a very fair summary of the difficulties of working the 150th section of the Public Health Act, and I may also say that the supplementary remarks of Mr. Spinks have removed some of the points that I was going to raise. It was two or three years since the Municipal Association tried to amend the 150th section. They introduced an Act for that and some other purposes, but they had never been able to get the Bill through Parliament. In 1883 the Birmingham Corporation got all that was necessary in that respect in their Bill; I have a summary of what the Bill contained. In 1884 the Birkenhead Corporation got in an Act on all fours with the Birmingham Bill. (Mr. THORBURN then read a summary of this Bill, which referred to private works, which he had prepared for the information of the meeting.) In addition, they have a previous Act of Parliament that left the matter of apportionment, as the surveyor, under all the circumstances of the case, might consider fair and reasonable; and I do not think their Act agreed in all points with the Birmingham Act, but I think that the two Acts are pretty much on all fours with the provisions promoted by the Municipal Corporations Association. They found one difficulty at Birkenhead, when a work was required to be speedily executed, as so much time was taken up on preliminaries before the work could be commenced. Any objection that was made had to be met, and the matter was settled before a penny was spent.

Mr. ROYLE: It affords me much pleasure in stating my experience of 35 years in works of street improvements, 25 of which I had to do with the Manchester Corporation Acts, and nearly 10 years with the Public Health Acts. With regard to the Amended Bill introduced into Parliament last session, I am glad to say that it died a natural death, and hope that, in its original form, it will rise no more. What is really required in any new Bill (with slight additions, viz., such as the last paragraph of Sect. 150) is to adopt the Manchester General Improvement Act 1851, clauses 15 to 37 inclusive; the Manchester New Streets Act 1853, clauses 41 to 44 inclusive; and the Public Health Act 1866; and also a clause in a later Act which gives power to flag backyards attached to courts and passages. All these several Acts could be made one, and from my long experience would meet all that is required in any new Bill for private improvements, as in no case have they failed, either in the service of notice, or the

recovery of moneys, whether from vacant land or buildings, the clauses being ample, clear, and distinct, and there being no summary jurisdiction clauses to hamper their working. In the case of no owner of land being found, power is given to lease the same from time to time, till the debt is paid off, and in the case of an owner of property refusing, or who could not pay, power is given to collect the rents. The paving and sewering of streets and passages are invariably ordered at the last moment, when either the drainage or surfaces are in bad condition, therefore the work of completion should not be hampered or hindered by clauses giving owners the power of appeal or objection, or entailing unnecessary labour on a surveyor in providing preliminary apportionments. I have therefore great pleasure in recommending to the Association, and especially its Parliamentary Committee, the Manchester Acts for paving and sewering streets and passages, which will well repay them in considering recommendations in the proposed Bill for the amendment of the 150th Clause of the Public Health Act. It may to some seem arbitrary, but such is my past ten years' experience, that after Local Authorities give notices to pave and sewer, and in cases before such notices are given, on no account should owners of land or property, nor lords of manors, or their surveyors, be allowed to carry out these works, not even in the sewering of intended streets, for the purpose of developing their estates, and then ask the authorities to accept them. All such work ought to be done by the authorities and no one else.

Mr. Stafford: In Burnley, we pave many streets with local setts of the first quality, and "grouted" with pitch or asphalte, and in the back streets we pave with an inferior quality of setts, and "grouted" with gravel, that was thought sufficient for the *cul-de-sac*, or back street. In our Act for Burnley it was stated that neither a railway company nor canal company should be called upon to pay costs for a street running parallel near their line or station, provided that the railway or canal company did not use such parallel street and had not a building on it. But I think on the other hand, that it is very hard against the owner or owners of property on the other side of the street, because the clause went on to say that in such a case the owners abutting on the street, on the other side of such street, should pay the whole of the expenses for the total width of the street. I think that is hard upon the owners. With regard to a steam-roller going over

a sewer seven or eight feet deep, in reference to which a question has been asked, I have had some experience of this, and have never had occasion to repair or take up any sewer that has been so treated. Something should be said about provisional apportionments. In Burnley they apportioned a street according to the frontage, for the total amount expended on that street; and in cross streets, going into a street to be apportioned, the cross street is distributed over the whole frontage; and in a case that has been heard at Burnley—the Corporation *v.* Schofield—the Judge decided that the Corporation were right. There is also the question of estimates for street works. In paving a batch of streets, to make an estimate, and apply to the Local Government Board for power, seemed a great deal of trouble, but in Burnley they have borrowed, with the permission of that Board, 10,000*l.* in perpetuity. They have got 10,000*l.* of floating capital, and when they had a batch of streets to make, they issued notices, paved if the owners failed to do so, sewered, levelled, flagged, &c., and took the cost out of the 10,000*l.* until they could make the apportionment. Then they recouped themselves and made up the money again.

Mr. Vawser: The short discussion we have had shows that a great deal more might profitably be said on this subject, and I hope there will be found further opportunities to discuss this important subject in other districts before the next Bill is brought into Parliament; one thing struck me forcibly as Mr. Thorburn alluded to it: that whilst large Corporations can obtain important Acts of Parliament for their own districts, and from which they and they only derive benefit, it has become almost impossible to pass a general Act of Parliament dealing with the whole country. There are present many Members of the Association representing large boroughs, who could tell you that in their own towns many of the reforms we advocate have been introduced, but in the great majority of cases it is impossible to obtain them. Another point has been raised in the course of the discussion, by Alderman Davies, in reference to the street alongside a railway. This particular case is a matter of local interest, but I have not the slightest doubt but that the railway company is in the first instance liable for the repair of the road, the frontager is always liable to pay the costs. With regard to serving owners with notices, I think it is pretty well understood that by serving notices on the agents, or others who receive the rents, the authority does really place itself in a position to recover. When I was in

Warrington a good many years ago, notices were served on a great number of owners, and, to the best of my recollection, there were only one or two cases where we failed to recover the cost. I think that if a surveyor used ordinary care to take particulars as to the owners of property, there would be no risk of the authority losing any money. With regard to apportionments, I think that owners should be called upon to pay as soon after the works are completed as possible, and if the time for repayment is extended I should say that five years is quite long enough. I agree with the remarks by the other Members as to the skill that Mr. Spinks has shown in preparing his paper, and I am very glad to think that the paper is generally approved by the Members of the Association.

The PRESIDENT: I do not think there should be different classes of specifications for private street work, except so far as refers to the difference between a back street and an ordinary one. If a street from its situation becomes a great thoroughfare it is, in my opinion, the duty of the authority to pay any extra costs of making up such a street. It is perfectly hopeless that such clauses as Mr. Royle alludes to in the Manchester Acts should be enacted in a general law. I have already, at the Rochester meeting, given my reasons for believing that the proposed Bill would on the whole be a most valuable improvement on existing powers.

CORRESPONDENCE.

Mr. MAWBEY: I have, from experience, found it very undesirable to execute the works by the staff of the Local Authority, the system being a fruitful source of complaints, on the alleged grounds of indolence of workmen, waste of materials, mismanagement, &c., however well and cheaply the work is done. And whilst admitting the advantages in quality of work and material, when executed by the Local Authority's staff, I think it much more satisfactory to all parties, to do the work by contract on the "Schedule system." The schedule system is convenient in cases where some of the owners are indiscreet enough to execute part of the work themselves as has recently been the case at Lynn. I do not however think that owners should have the opportunity of doing the work

themselves, but should be compelled to pay to the Local Authority the accepted contract prices obtained by public advertisements.

Mr. Santo Crimp: I have a curious case at Wimbledon, where, in a *cul-de-sac* street, the owner at the end whose plot was a meadow, and the owner of the house on each side abutting on the end, wished to comply with the notices served under the 150th section, naturally, because they would have such a small portion to make up; but the owners of the houses could not agree with the owner of the meadow land as to the amount each should do, and I had to decide. In this case, as the owners did the work, their expenses were much less than if they were rated in accordance with the other frontagers. In my opinion the frontagers should not have the opportunity of doing the work themselves.

Mr. Earnshaw: I am of opinion that the quality of work in different classes of streets is certainly a difficult problem to solve satisfactorily. The author, on page 19, suggests that the character of the streets should be considered, and divides them into four different classes, but only deals with the materials for three classes. I am afraid if that were so, the authorities would often find themselves in a "hornet's nest," as there would be many controversial opinions, not only amongst themselves, but amongst the owners of property in the street. Some would maintain it belonged to one class and some to another; some owners would be willing to have and to pay for the best class of materials, some for an intermediate class, and others would want the cheapest in first cost, and materials of the most inferior kind, especially as they are liable to be called upon a second time, or oftener, to repair such street. I would suggest that a hard and fast line should be adhered to for one class of materials in all streets that are thoroughfares, and another class in *cul-de-sac* streets, and that if the authority wished to have the most superior kind of materials used in some streets, then the difference in cost should be defrayed by the ratepayers, as it would be perhaps of more benefit to the public and not always so to the owners of property in such streets, because a superior roadway has a tendency to attract the greatest amount of traffic which is not always beneficial to the property adjoining, especially residential property.

With regard to premises, I think it is only reasonable that railway and canal companies should be freed from contributing to the costs of adjoining streets where they have no beneficial interest, otherwise there would be nothing to prevent a landowner laying

out a continuous line of streets alongside any railway or canal, which, in my opinion, would be a great hardship upon such companies but no doubt very beneficial to the landowner; but I would not exclude their stations, goods yards, or other premises abutting upon any street, and I would include all sidings. I may say that in my town such streets referred to have been so laid out, and without consulting the railway company.

I quite agree with the author for the reasons given that Local Authorities ought to have powers to execute partial works in a street; because I am of opinion it is unwise to pave and flag all streets until they are muchly built upon, especially such as are not thoroughfares or where the traffic is very slight, and nothing is so detrimental to a street to have to pull it up in order to lay down cross drains to property and for other purposes. There is no doubt that care should be taken to design the sewers to be of sufficient capacity to receive all the sewage, not only of its own street but also from all others which are intended to be discharged into it from other parts of the district, but it is only reasonable that the Authority should pay the extra costs of any extraordinary sewer.

I quite agree with the author that authorities executing the works by their own men, the costs of which are to be charged to owners of property direct, leads to great dissatisfaction, as I have experienced that in another town. It also entails a great amount of additional work upon the Surveyor's department; besides, in my opinion, it is wrong, and not contemplated by the Act that a Local Authority should take the place of contractors for trading purposes in matters of this kind, and should be prevented in any future legislation.

This is another problem very difficult to solve so as to be equitable all round. My opinion is, that the costs of the works should be apportioned amongst the owners according to the frontage of their land to the street, exclusive of any portion of such land as forms part of any side or cross street, except it be a private road, such as a carriage-way leading through private grounds. I may say that up to 1878, in my town, it was the custom to measure the frontages so as to include all side or cross streets, and I know from previous experience there were many complaints and objections to that method especially from owners of corner plots; the owners were also charged for the actual work in detail executed opposite their respective properties, which also did not give satisfaction,

especially where there was extraordinary work caused by inequality in the levels, and other matters; but when I took office in the year referred to, I adopted the nett frontage system of measurement, and was supported in that method both by the late and the present Town Clerks. I had some difficulty at first in satisfying not only the owners but my Corporation that it was the least objectionable method to adopt, but when I explained it to them by diagrams, I convinced them that it was so, and we have now no difficulty in the matter, in fact we have it now made legal by our Improvement Act of this year, and with the author, I should like to see it made so in any future amendment of the Public Health Act.

I may also say that by our Special Act we have power to charge a sum not exceeding 5 per cent. upon the costs of the works as supervision cost. With regard to the apportionment of costs in streets of unequal width, I do not think it would be wise to adopt any other than the present method, because if you apportioned as per rateable value, the equality in that case is uncertain, and so it would if you charged the actual area in front of each property, and therefore it would lead to unpleasantness in every case. But I do think some provision ought to be made in any future amendment for apportioning in cases where there are large open spaces, such for instance as a junction of streets not at right angles, which in some cases cause the junction for some distance to be wider than either of the two streets. I think the portion in the centre which exceeds the full width of the street should be charged to the Authority.

Mr. Swarbrick: At Withington, the amount expended on private improvement works during the last eight years has been 50,000*l*. As to dedication, Mr. Spinks says a surveyor should take all reasonable precaution to ascertain that the road has been dedicated; he also points out that, the fact of a street being laid out is not proof of dedication; he does not define the word "dedication." Ten years ago the practice at Manchester was, that, after submitting the usual street plans, a person laying out a new street had to meet the City Surveyor accompanied by the District Surveyor and Building Surveyor, as witnesses, upon the street which he previously caused to be nicked out upon the ground, and then and there in the presence of the witnesses declared that he dedicated to the use of the public for ever the street shown upon the plan and defined upon the ground. This formality was, in fact, made an invariable condition precedent to the passing of

any plans for new buildings. The above precise mode of requiring formal dedication was, I understood, carried out at Manchester on the advice of the eminent Town Clerk, Sir Joseph Heron. One of the speakers said that in his town the mere submission of estate plans showing new streets was regarded as dedication. The author does not distinctly state that dedication must be a condition precedent to the enforcement of the 150th section of the Public Health Act 1875, but that is, I think, implied in what he states under the head of street (p. 11). If that be so, then I think the Members will realise that in the following case, which is one of a number that the writer has met with, the intention of the Legislature would be frustrated and the power supposed to be given to Local Authorities can be rendered useless. A landowner having undeveloped building land, half a mile from a highway, in a district having no Urban Sanitary Authority, purchased from several adjoining owners a right of road from the highway to his land, over a road varying from 8 yards to 10 yards in width and which was originally intended to serve as a carriage entrance for several large detached houses. Years passed—a railway made the land saleable, and a Local Board was formed. The building bye-laws were of a common type, requiring that all houses should front 12-yard streets, and according to these the landowner laid out his land and sold it to builders. He could not dedicate to the public the road over which he had only a right of way, and he declined to dedicate formally the streets he laid out and formed. The Authority had no bye-law to compel him. There is also another somewhat similar case which I remember. The owner of a detached estate purchased land for a means of access to the main road through a district. The owners of the land required for the road would only sell on condition that houses of a high rental should be built fronting the road and that it be used only as a means of access to the detached estate and not as a public road. The person laying out the road could not therefore dedicate it to the use of the public for ever. One of the roads in question was certainly often in a state of repair unsatisfactory to the Local Authority, and when an attempt was made to require repairs, or permanent works, the power of the authority was questioned. The owner alleged that the street was private, for the use of his estate, and had never been dedicated. So far as my knowledge goes, the power of the Local Authority was not tested.

As to sewers, the amended Bill ought to prescribe the maximum size, depth and probably the cost which a Local Authority can impose on frontagers for sewerage works. It is, perhaps, wide of the present question, but I have long thought that all sewerage charges ought to be chargeable, according to rateable value, upon the occupied premises. This rule acts with regard to the cost of the mains which supply the water consumed. Why ought it not to apply to the cost of the mains which discharge the water consumed? The following may appear a minor point, but if an authority wishes to put a larger sewer in a street than is necessary for the street itself, it would appear that the better course would be to show the larger sewer on the drawings, but charge for a smaller one, because, if the smaller one be shown and charged for but a larger sewer laid, then there would be a palpable deviation from the plans and, though no injustice would be done, an opportunity for litigation on a technical point would be afforded.

In reference to levels, it would be well if Local Authorities had wider and specific power with regard to levelling streets. To me, it does not seem too much to empower an authority to deviate from the existing levels of a street, at the owner's expense, say one foot, to secure a more uniform longitudinal contour, or to allow of suiting the levels of cross streets, thresholds, steps, floors, &c. These things often lead to shortening or lengthening of doors and gates, or to re-hanging the same, and in some cases to underpinning walls and buildings. Such charges should form a part of the general charges for the work unless there are special reasons why they should not. The cost of retaining walls or slopes to support the earth and materials forming the street, or to retain banks adjacent to the street, should in like manner form part of the general account.

With regard to the charge for the preliminary examination of the sewers, surveys, levels, plans, and sections, detail drawings, quantities, estimates, advertising and serving notices, I hold a very decided opinion that *so long as private improvement works remain chargeable to property owners*, the above expenses are in every sense part of the private improvement expenses, and therefore ought to be, forthwith, made legally chargeable upon the owners. I can see no more logic in saying that the town surveyor and his staff ought to do the above work at the ratepayers' expense for negligent property owners, than that the town paviors and masons should go into each private street when the works are in progress,

to assist in paving and flagging part of the street at the ratepayers' expense. It is to be regretted that, with the law in its present uncertain state, Local Authorities do not regard the above charge as a means of employing an adequate staff to effectually supervise an important section of sanitary work.

With reference to the question of varying the character of the works to be executed so as to be more in harmony with the exigencies of traffic in the various parts of an urban district, there is much to be said in favour of such a system, but it has this drawback, that where it may be justifiable to-day to adopt the least durable kind of work and therefore the least expensive, if the street so completed be accepted as a highway repairable by the inhabitants at large, then, if the requirements of the traffic demand more costly and durable materials, they must be provided at the cost of the ratepayers. I should think that in Lancashire the method of adopting a medium standard of work, say dressed kerb of solid self-faced rock, flagging of similar material, and well-dressed grit setts, grouted with asphalte, would answer all practical purposes, with this proviso, that the authority may at any time use a better material, if they pay the extra cost thereof, and if the authority think fit, on the application of two-thirds of the owners in any street, they may be empowered to execute any less expensive work with materials more suitable for streets with lighter traffic, if the owners pay for the standard class of work according to the surveyor's estimate.

Lastly, one speaker questioned whether in any Act, Metropolitan or other, provision had been made to deal with streets, situate in the districts of two authorities. The 23rd clause of the Manchester Improvement Act 1871, empowers the Manchester Corporation, with the consent of any Local Board whose district adjoins the city, to serve notices upon the owners of property in any street in a local government district, partly in the city and partly in such adjoining district, to execute private improvement works as though such street were wholly in the city.

Mr. ROUNTHWAITE: I agree with Mr. Spinks that amendments might, with advantage, be made to this section; but that the procedure under the present Act is cumbrous, or that it has often led to litigation, I take exception, so far as my experience goes. In the six years, 1881–6 inclusive, I have made approximately 6000 apportionments of the cost of private street works, amounting to upwards of 55,000*l.* and, of these apportionments, not more than

ten had been disputed, and only two successfully, whilst there has been but one appeal to the Local Government Board. Such results, I submit, speak favourably for the working of the Act.

I question very much the advisability of adopting Mr. Spinks' practice in requesting owners to examine the apportionment and point out mistakes.

"*Apportionment*."—I submit that a Local Authority may charge all out-of-pocket expenses as a part of the cost incurred in executing the works.

"Appeal to the Local Government Board."—The case referred to by the author under this head is somewhat startling, for any decision of a committee could only be in the form of a recommendation to the authority, unless, indeed, the authority had power to, and did, delegate its duties to a committee.

Public Health Acts (*Improvement Expenses*) *Bill*.—I certainly approve of the proposed amendment as to the service of notices, for, as a matter of fact, not one person in a thousand ever thinks of doing himself the work set forth in the notice. On the other hand, I strongly disapprove of the suggestion that the duty of the Local Authority should be placed in the hands of a bench of magistrates who cannot possibly have the knowledge, experience, and practical information that a highway committee has. I think it is altogether absurd to submit to the Local Government Board, or to a bench of magistrates, such questions as whether or not a street *ought* to be paved, and the description and quality of paving; it will constitute the magistrates a Local Authority (for highways). The suggestion of the author as to inviting inquiry by the Local Government Board appears to me to be tending towards centralisation with a vengeance. He well puts it, three pages further on, under "*Sewers*," that "These matters of scientific knowledge cannot well be decided by magistrates or any other law court"—I *entirely* agree with him.

The power which the Bill gives by clause 7 to apportion the cost of private street works according to the degree of benefit derived by particular premises, and with regard to other considerations than frontage, opens a wide field for contention amongst the Members of a Local Authority. There is no rule laid down for guidance in applying this new principle of apportionment, and in carrying it into effect, the decisions of the various authorities would be of the most capricious character, leading inevitably to disputes and litigation at the instance of the owners affected.

Not only may the provisional apportionment be disputed, but, when the works are completed the final apportionment may, by clause 9, also be disputed for any of the several reasons enumerated therein. One of these reasons is that the actual expense has without sufficient reason exceeded the estimate by more than 15 per cent. The direct effect of this, it is submitted, would be, that, to avoid such dispute, the surveyor would, in his provisional apportionment, keep up the amount of his estimate higher than he would otherwise do. As to the other grounds for disputing this final apportionment, I submit that, in the carrying out of private street works, they have been found to be entirely unnecessary.

By clause 14 it is proposed that an authority may, at any time, resolve to contribute the whole, or any portion of the expenses of private street works, and pay the same out of funds applicable to the like expenses in respect of highways repairable by the inhabitants at large. This power would give rise, in many instances, to long and acrimonious discussions amongst the Members of a Local Authority, and open a wide field for the benefit of individual interests at the public cost.

The facilities given by the Bill for disputing or delaying the proceedings of an authority at every stage, must result, in my opinion, in affecting injuriously the interests and health of the community.

At the close of the Discussion the Members adjourned to the Lion Hotel for luncheon, which was provided at the cost of the Mayor, after which, under the guidance of Mr. Longdin, the Members went in conveyances to inspect the air compressors for working Shone's Ejectors for the Latchford sewerage, and afterwards paid a visit to Lythgoe's Lane Intercepting Depôt, and the Manufacturing Depôt at Longford. They then returned to the Town Hall, where several Members expressed the pleasure and profit they had derived from their visit. Votes of thanks were cordially passed to Mr. Alderman Burgess and to Mr. Longdin for their valuable services to the Association. These gentlemen suitably replied, the latter remarking that he hoped to prepare a paper on the subject of Sanitary work at Warrington, and read it at a future Meeting of the Association.

DISTRICT MEETING AT PORTSMOUTH.

June 4th, 1887.

Held in the Council Chamber, High Street.

Mr. J. Lobley, *President, in the Chair.*

The Mayor (Alderman W. D. King, J.P.) received and very heartily welcomed the Members to Portsmouth, after which the following paper was read:—

THE DRAINAGE OF PORTSMOUTH.

By H. P. BOULNOIS, M. Inst. C.E., Borough Engineer, Portsmouth.

There have been already two papers presented to this Association upon the subject of the Drainage of Portsmouth. One of these papers was contributed by Mr. Lewis Angell, M.I.C.E., our first President, and the other by Mr. Greatorex, who was then the Borough Engineer of Portsmouth, but who has since died. These papers will be found in the 4th volume of our 'Proceedings.'

It might therefore appear almost unnecessary to present a third paper upon this subject for the consideration of the Association, were it not for the fact that considerable additions and alterations to the original works have been recently carried out, and it is these works which I shall now endeavour to describe to you and ask you presently to inspect.

If you refer to Mr. Angell's paper, to which allusion has been made, you will find that the borough of Portsmouth is there described as being situated on an island, that its formation is of the Tertiary period, and that it is nearly a dead level all over. "The highest, busiest, and most densely populated portion of the borough is elevated only about 12 feet above the tidal range, while about one-third of the borough is very little above the level of ordinary spring tides, and includes a large extent of marsh."

These are Mr. Angell's exact words, and under such conditions

we all know the difficulties and obstacles there are to a gravitation system of drainage.

Mr. Angell, however, made the best of a most difficult task, and laid out a scheme of drainage which was submitted to, and approved by, Sir John Hawkshaw, the Admiralty and War Departments, the Secretary of State for the Home Department, was adopted by the Corporation of Portsmouth, and eventually carried out, the works being commenced in the spring of 1865.

This scheme was shortly as follows:—A high-level sewer, commencing at what is known as North End, passing through the Commercial Road, part of Somers Road, and Elm Grove into Albert Road, Highland Road, and Henderson Road, to the pumping-station at Eastney. There is now a further branch, a portion of which I have myself recently extended, commencing at Copnor and also at Buckland, passing along the Copnor and Milton Roads, and joining the main high-level sewer close to the pumping station. The total length of the high-level main sewer is about 8 miles. The low-level commenced in Portsea, passed through Portsmouth, across Southsea Common, along Lumps Lane and Henderson Road to the pumping station. A branch commencing in the Commercial Road at Landport, connected with it near the Pier Hotel, Southsea. The total length of the low-level sewer is about 6 miles. In the Henderson Road the high- and low-level sewers were constructed one above the other in the same trench for a distance of 800 yards before entering the pumping-station. Here the sewage in the low-level was lifted by a pair of 25 horse-power rotative condensing beam engines into the high-level sewer, and from the pumping-station both sewers discharged by gravitation to a point most judiciously selected by Mr. Angell near the entrance to Langstone Harbour, the only point upon the sea-board of the island of Portsea where sewage could be discharged with the least nuisance.

On account of the levels of the outfall sewer, the sewage of the borough could only commence to discharge at about one hour after high water, at which time the high-level sewer commenced to discharge by gravitation, and the pumps were put into operation to lift the sewage from the low-level sewer; thus during some five or six hours out of every twelve the low-level sewer was tide-locked, and for a slightly shorter period the sewage in the high-level sewer was also ponded back.

When it is added to these drawbacks that the gradient of the

sewers was necessarily very flat, some of the mains being only 1 in 5280, whilst the arterial drains were only 1 in 650, it is scarcely to be wondered at that deposits took place in the sewers throughout the borough. In the year 1882 the state of the sewers had become so bad that the Corporation, after inviting competitive schemes for the effectual dealing with the system, called in the aid of Sir Frederick Bramwell, M.I.C.E., F.R.S., &c., who, with the assistance of Mr. Harris, M.I.C.E., his Chief Assistant, prepared and presented to the Corporation an exhaustive report upon the condition of the sewers, and advised certain works being carried out with regard to them, and also a scheme for ensuring a constant flow through the outfall, at the same time securing that the flow of the sewage into the sea should be on the ebb tide only. These are the works which are now just completed, and which I shall presently ask you to inspect, but before doing so it will be well to give you the following description of them, this description being partly taken from a report presented to the Town Council at the recent ceremony of opening the works.

The new works consist of a sewage collecting tank, constructed on a piece of ground which the Corporation obtained from the Governmental authorities near Fort Cumberland. This tank, or rather series of three tanks, is competent to contain all the sewage produced in the district during any one tide, not only from the present population of about 138,000 inhabitants, but also from the population of twenty years hence, estimated to increase at the rate of the last decennial period, from 1871 to 1881, and competent also to contain (with the same increase) the sewage of that portion of the borough, i. e. Stamshaw, lately drained, the sewage of the Government establishments, and a proportion of the surface water from those districts where the surface water is not separated from the sewage proper. The tank has therefore been made capable of containing when full as much as four and a half millions of gallons, and it covers an area of nearly three and a quarter acres.

In this tank the sewage will be stored during those hours when the tide is rising, and also during those hours when it has fallen so low as to render it inexpedient to discharge into the harbour, that is to say, for about eleven hours out of every tide. With the object of allowing the outflow to begin at such early period after high water as may be found best in practice, the sloping bottom of the tank has been placed only one foot below ordinary high water.

The tank is divided into three distinct and practically equal

compartments, any one of which can, if necessary, be thrown out of use for repair. Advantage has been taken of this construction to make the tank self-flushing, that is to say, it has been so arranged that the contents of any full compartment can be used to flush an empty compartment, and although, as the tank is filled by pumping, and not by gravitation, there should not be any sewage in excess of its capacity pumped into it, yet each compartment of the tank is provided with an overflow into the outlet culvert.

At the request of the military authorities, a provision has been made for ventilating the tank by means of a chimney having in it a furnace kept continually burning, so as to cause an efficient draught; the inlet of the air for this ventilation is at the shallowest end of the tank, the chimney through which the air is carried being 90 feet in height.

In order to insure the rapid discharge of sewage, which is essential in this scheme, the outlet culvert has been made 7 feet by 6 feet, from which proceed three lines of cast-iron pipes, each 3 feet 6 inches in bore, standing out from the shore into the entrance to Langstone Harbour a distance of nearly 600 feet, and having their open ends placed slightly below low-water mark, and delivering well into the tidal stream. The laying of these pipes has been a work of great difficulty and some danger, owing to the swiftness of the tidal current and to the exposed nature of the shore at this point.

The arrangement for lifting the discharge valves in the tanks is of an ingenious kind; it is effected by the action of the sewage itself upon turbines which raise the valves. Thus considerable time and labour are saved, and I hope when we inspect you will direct particular attention to this point.

A long series of experiments were made under Sir Frederick Bramwell's directions during the winter and spring of 1883 and 1884 in all states of the tides, and during all sorts of weather, to determine, by means of floats, to what points the sewage would be taken, if delivered at the proper time from the new outfall pipes, and in every case in these experiments the floats were carried many miles to sea—never approaching the shore, thus confirming Mr. Angell's selection of this point as the best in the borough.

The tank has been constructed with Portland cement concrete walls lined with brick set in Portland cement mortar, there being a straight, thick water-tight joint between the face of the concrete and the brick lining. The floor is in Portland cement concrete, worked to parallel inverts sloped towards the outer culvert and

"rendered." The roof is composed of brick arches carried on brick piers, and on the lining walls, with concrete backing to the haunches, the whole earthed over and sown with grass and clover seed. The discharge culvert, and the flushing culvert and the discharge chamber, are of Portland cement concrete similarly lined with brickwork.

The height at which the tank is placed is such that the supply connection to it from the pumping station is under pressure, and thus the connection between the two is made by a cast-iron main or pipe. In order to allow for the irregular flow of the sewage and of rain water, and so as not to sacrifice power by undue friction, this main, which is nearly 1500 yards in length, has been made as much as 3 feet 6 inches diameter of bore. The load on the new pumping engines is equalised, and accidents are guarded against by providing a standpipe in the engine-house premises, into which the sewage is pumped, and from which it passes into the cast-iron main. This is carried underground, generally parallel with the present brick outfall sewer, until a point is reached about 500 yards from the engine house, when it runs to the north-east, so as to approach the tank at its north-west angle, and is then extended along its west wall, being connected to the tank so as to fill all three compartments.

Having regard to the elevation of the tank, the whole of the sewage will have to be pumped, and having regard to the fact before stated that the sewage comes down in unequal quantities, and not by an average flow, and also that surface water has to some extent to be allowed for, the pumping power is very considerably in excess of that previously in use.

The two new pumping engines are each capable of developing 150 indicated horse-power. They are compound, condensing beam engines, with cranks and fly-wheels; the pumps (two to each engine) being worked direct from the beam.

The pumps are double-acting plunger pumps, and draw from two sumps outside the engine house. Into these sumps the main high-level and main low-level sewers fall, the invert of the high-level sewer at this point being about 15 feet, and the invert of the low-level sewer about 20 feet below the surface of the ground. By an arrangement of sluice valves on the suction pipes it is possible for each pump of each engine to draw either from the high-level sump, or from the low-level sump, or from both sumps together. The deliveries of the pumps lead to a standpipe, 24 feet high

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from ground level, and from this standpipe a cast-iron main, 3 feet 6 inches in diameter, conveys the sewage to the collecting tank.

The general dimensions of the engines are:—high-pressure cylinders, 20 inches in diameter, 4 feet 6 inches stroke; low-pressure cylinders, 30 inches diameter, 6 feet stroke; length of beam, 23 feet; stroke of crank, 6 feet; diameter of fly-wheel, 15 feet. The diameter of the pump plungers is 2 feet 6 inches, and the stroke 3 feet 3 inches. The total displacement of the pumps of each engine when running at twenty revolutions per minute is about 500,000 gallons per hour, but a much less quantity than this only is pumped with the ordinary flow of sewage. The pump valves are rectangular, leather-faced clack valves, on inclined seats; there are three suction and three delivery valves for each end of each pump.

The boilers, which are in a house adjoining the engine house, are four in number. They are double-flued boilers, each 7 feet in diameter and 27 feet long, set in the usual manner, the flues being connected to a circular chimney shaft 120 feet in height.

The engines and boilers are by Messrs. James Watt & Co., of Soho, Birmingham.

The principal dimensions of the engine house are:—length inside, 40 feet; width inside, 30 feet; total height from basement to ridge of roof, 72 feet, of which 23 feet is below floor level. The roof, which is high pitched, is partly supported on the two lattice "lifting girders," one of which is over each engine. On the lower flange of each of these girders is a small lifting carriage, which may be fixed in any position in the length of the girder by a brake block taking against the bottom of the girder; to these lifting carriages may be attached blocks or other lifting tackle.

The existing engines have yet to be altered so as similarly to receive their pumping supply from the high and low-level sewers, and to deliver into the new outflow main. When the whole scheme is completed the two new engines, or one of the new engines in conjunction with the existing engines, will suffice for the work, thus giving a stand-by engine to go to work when needed.

The engines, or one of them, will be kept continually at work, night and day, from one year's end to the other, so that the sewage will be taken away to the collecting tank as it arrives at the pumping station, and will not be allowed to "back" up in the sewers of the town, as it now does for hours together; thus all evils attendant upon the present state of things will, it is believed, gradually disappear.

A large amount of reparation and renewal of the sewers in the borough has also been done during this last four years, but much has yet to be performed, and there is no doubt but that, as soon as the new scheme is put into operation, a systematic flushing of the sewers and drains will have to be commenced in order to put them into a satisfactory condition.

To convey some idea of the magnitude of the works which have been performed, it may be stated that about two hundred thousand cube yards of earth have been excavated, some of which has, of course, been refilled in over the work; nearly six million bricks have been used; seven thousand tons of Portland cement, for the making of concrete and mortar, with about thirty thousand tons of gravel, and eight thousand tons of sand; altogether also there will be something like three thousand tons of iron, of which about 350 tons, more or less, will be in the engines and boilers, and pipes, &c., in connection with these, the remainder being in the cast-iron main from the pumping-station to the tank, in the outlet pipes into Langstone Harbour, and in the screw piles, &c., for securing these, and in the valves, covers, and plates, &c., throughout the works.

In conclusion, I need scarcely tell you that this is only a mere sketch of the large works which have been carried out. I hope to be able to furnish a more detailed account of them to be entered in our 'Minutes of Proceedings,' but I felt that a longer paper would only have detained you from the inspection, and my intention was to give you only a short outline of the principal points of the work, so that you should more clearly understand them when you visit them, which I now ask you to do.

THE NEW TOWN HALL, PORTSMOUTH.

By H. P. BOULNOIS, M. Inst. C.E., Borough Engineer, Portsmouth.

The new Town Hall of Portsmouth now in course of erection from the designs of Mr. William Hill, F.R.I.B.A., Architect of Leeds, and under the superintendence of Messrs. W. Hill & Son, of Leeds and Portsmouth, stands upon a site containing 3½ acres acquired by the Corporation (partly by purchase and partly in exchange for other land) from Her Majesty's War Department.

When the existing boundary wall and old buildings are removed, the east or principal front of the building will be seen at a distance of 160 feet from the centre of Commercial Road, the chief thoroughfare in the borough, and near the Central Railway Station. The south front of the structure faces a wide road called Park Road, and is 90 feet from the Gas Company's offices, the nearest building on that side; the west front is open to a portion of Victoria Park, and the north front is also open to this park, but unfortunately separated from it by the railway embankment which cuts off the whole of the basement of the building, and about 8 or 9 feet, or one-fourth, of the order of pilasters from the spectator's view in these ornamental grounds.

The following are the leading dimensions of the building on plan, viz. the east and west fronts from north to south on the plinth line 185 feet, and through the centre in the same direction 206 feet, and from east to west 164 feet and 194·6 feet respectively, the total area covered being 35,380 superficial feet, the cubic contents of the structure being approximately 2,500,000 feet.

The undermentioned figures give very closely the areas allotted to the several departments falling under the head of Municipal Offices—

On the east, or principal front, immediately north of portico, on the basement or ground floor, are the Rate Offices, four in number, covering an area of 1650 feet superficial. On the north front beyond north-east stairs, is the Sanitary Department, the Inspectors with 925 feet, and the Medical Office with 700 feet, the north main

entrance to principal floor bisecting these offices; 380 feet is then taken for lavatories, &c., and hall-keeper's and porter's rooms (together 560 feet) fill up the north-west angle. Next to these on the west front come two staircases, a separate one to the Borough Courts, and another to principal floor; beyond this the Police Cells, eleven in number, with corridor and stairs to court, occupy an area of 2500 feet. Contiguous to these the Police Department with two entrances, and numbering eight rooms, takes up 1790 feet of space exclusive of stairs to floor above and corridor to cells. Passing the south main entrance to next floor we find the whole of the south-east angle of the building from the last-named staircase to the portico, devoted to the Public Library and Reading Room, together occupying 5260 feet, and an additional space under great hall of 1100 feet for store-room purposes, the rest of the space under the hall being distributed as follows, viz. 800 feet to heating and ventilating apparatus room; 2300 to Police Parade; and 1500 feet to store and testing rooms; a further area of 3790 feet is taken by the corridors and stairs before named.

Following the same order as below we find, on the principal floor east front, the parts north of centre allotted to book-keepers, cashier, clerks, &c., with a similar amount of rooms as in the Rate Offices below, and connected with these and the Town Clerk's offices above by a private staircase by which the strong room in the tower can also be reached. On the north front are cloak and retiring rooms on each side of north entrance, embracing an area of 1600 feet superficial. Beyond these are the barristers' and solicitors' rooms, filling, with the stairs, the north-west angle. The west front on this floor is given up to the Borough Court, magistrates' and witnesses' rooms, &c., &c. The court, running up through both floors, measures some 50 feet by 40 feet, in which is also a separate gallery for the public. An apartment on the south front is set aside for a Coroner's Court, containing 560 feet.

From the centre of this front to nearly the centre of the east front are located the Borough Engineer's offices (over the Library). Of this space the drawing offices take some 800 feet. Borough and Deputy Engineer's 740 feet, while the Public Road Surveyor and Improvement Surveyor share 1260 feet between them, making a total of 2800 feet superficial allotted to this department.

The height of this floor is 17 feet 6 inches from the floor below, the basement floor being 16 feet from floor to floor.

The above-named offices are all reached from a corridor 10 fee

wide, surrounding the great hall which is 108 feet in length by 70 feet 8 inches in width, exclusive of semicircular apsidal projection at the south end to receive organ.

On the first floor the 10 feet wide corridor in communication with three staircases is carried round three sides of great hall and connected with the balcony by eight doors on the inside and with the various rooms herein described. On the outside on the first floor, viz. opposite the portico, we get the Mayor's reception room in the tower; north of this comes the Mayor's parlour with 400 feet area; adjoining are the Town Clerk's offices, three in number, containing 800 feet superficial; facing the north we get the Council Chamber, a fine apartment with about 2000 feet floor space. Committee, robing, and other rooms occupy the rest of this front. The upper part of Borough Court, Grand Jury and other rooms also fill up the west front on this floor.

On the south of main hall beyond the apsidal end forming organ gallery, the remaining space (1400 feet) is set apart for a museum, over which the kitchen and culinary department will find a home. Returning to the east front we reach the banqueting room, a fine apartment, 72 feet by 25 feet 4 inches, with the mayor's reception room and parlour *en suite*, and opening into the upper corridor. Should the fittings of the Borough Court *not* interfere with the view, a very unique effect will be obtained by opening all the doors on the principal floor from entrance hall across the minor axis of the building in the centre, and through the centre window of the court, the view will extend over the railway to a distance of some 400 yards westward till lost among the trees in the distance.

The great hall will be 60 feet high to the panels in the deeply coffered ceiling, round which will run a deep cove pierced by the numerous semicircular windows that light the hall above the adjoining roofs; beneath this cove an enriched entablature runs round the hall carried by a series of pilasters. There are two orders of these divided by the balcony before described.

The ventilating and warming arrangements are in the hands of Messrs. Haden, of Manchester. The numerous flues for the supply of warm and fresh air to every room in the building, together with the extraction shafts for vitiated air, are in the course of construction from the designs of these gentlemen.

The style of the building is Classic, of a Roman type, and entirely carried out in Portland stone from the bed known as the white or brown bed. A rusticated basement with a bold plinth, above

which are the ground floor windows 9 feet 6 inches high, reaching to the surbase 17 feet from ground level, runs all round the building. From the top of this surbase starts the order of columns and pilasters, also surrounding the building; these are 3 feet 4 inches in diameter and 10 diameters (33 feet 4 inches) in height, and run through two floors, with a string-course marking their division, the surbase marking the level of principal floor.

The columns and pilasters carry an entablature 8 feet 6 inches in height, surmounted by a balustrade 5 feet 3 inches high. In the centre of the east front, and standing 21 feet in advance, is a hexastyle portico 57 feet wide, reached by a pyramidal range of steps; on each side of the portico, and on the same level, is a loggia, 57 feet long and 6 feet 6 inches deep, with four columns in each and double pilasters at the angles. On the south the centre advances 10 feet 6 inches, carrying four three-quarter columns and coupled pilasters. The north and west fronts are treated similarly, but with pilasters only. In the centre of the east front, immediately behind the portico rises the clock-tower, the lower stage rising boldly without a break for 29 feet, including frieze and cornice, making a fine base for the belfry stage, which is enriched with pilasters, carved capitals, and panelled semicircular openings on each face, filled with ornamental iron grills; above the cushion frieze and cornice of this portion comes the still more highly enriched clock-stage, with dials 9 feet in diameter, surmounted by pediments and angle terminals; above this starts a copper-covered octagonal cupola or domical roof; over this again rises an open turret, with cupola, all in stone, the whole reaching to a height of 205 feet from the ground.

Taken altogether, the strong lights and deep shadows of the finely grouped and well-balanced masses, the carefully studied detail, the charming variety in size and outline of the turrets and cupolas emphasising the salient angles of the structure and leading up to the crowning central feature, unquestionably stamp the design as a grand, effective, and harmonious composition.

The foundations rest on a firm compact stratum of gravel throughout; the walls in all cases stand on a depth of 2 feet 6 inches of cement concrete, except the tower, which has a depth of 5 feet 6 inches under two courses of roach Portland stone covering the whole area.

The quantity of stone required for the whole building will be upwards of 200,000 cubic feet.

The contractors for the whole work are Messrs. Armitage and Hodgson of Leeds. The stone-sawing and working machinery introduced by this firm is quite a novelty in this part of the kingdom, as well as a most important factor in facilitating the work.

I am indebted for the whole of the foregoing particulars to Mr. Lawrence, the able clerk of works, who was appointed by the Town Council to superintend the erection of this important building.

DISCUSSION.

Mr. Angell: We are all so extremely satisfied with what we have heard and seen, that it is impossible to make any criticism, excepting that of compliment. Speaking for myself, the present work appears to be an elaboration of my own scheme to the extent which I foresaw at the time I was borough engineer for Portsmouth, but we had neither funds nor sufficient rateable value to justify our carrying out such extended operations at that time. The thing has now been done by Sir Frederick Bramwell, much better than I could have done, and I believe they have done the right thing. The difficulty in my own time was the expenditure. They spent about 100,000*l.* in bringing the sewage to this point. In getting it out to sea, I selected the same point as had been made the great feature of the present scheme. There was no question at that time of impounding the sewage. Sir Frederick Bramwell had now carried that out in a most satisfactory manner, we must all admit. I should like to thank Mr. Boulnois for the great courtesy he has shown us in inviting us here. The works we have seen, possibly the largest in the country, have been carried out in the most efficient way, and we are exceedingly well pleased at the courtesy of the Corporation, and of Mr. Boulnois, who had initiated their visit. After my own time, Mr. Greatorex succeeded to the position of borough engineer; he was a good hard-working, practical man, but it would be no detraction to him to say that Mr. Boulnois brought with him, not only practical, but also scientific knowledge. Of course we progressed in these days, and the position of borough engineer was an advancing one. We are pleased, therefore, to see a man of Mr. Boulnois's capabilities and knowledge occupying the position he does with so much success, and with such satisfaction to the Corporation of Portsmouth.

As to flat sewers, it was most desirable to get to the cause. The flat falls which I designed, I had very great doubt about, but the plans were submitted to Sir John Hawkshaw, and they also had the authority of Sir Robert Rawlinson for flat sewers. We had also a system of flushing down at the manholes let in at intervals, so that these were to be regularly flushed as often as was necessary. When they had to converge 70 miles of sewerage down to a point without getting down to the centre of the earth, and pumping it up again, it became a choice of evils. It was thought that those

flat sewers with proper arrangements for flushing would succeed, but we always recognised that it was a choice of evils. We all prefer good drainage when we can get it.

Mr. C. Jones: I reciprocate what Mr. Angell has said in such pleasing terms. He (Mr. Angell) had come down to look at the progress of one of his own children, and he is delighted that it has progressed so well in his absence. I am quite sure that Mr. Angell has felt all that he has said concerning those who have followed him, and preceded our friend Mr. Boulnois. I am especially glad that he has referred to Mr. Greatorex, whom we all esteemed highly. We are all pleased with the visit. I say this in the presence of some gentlemen who have not before been with us—those associated with the London districts—for I think it is indeed fortunate that they should have inaugurated their entrance into the circle of municipal engineers by a visit such as they had paid that day to Portsmouth. I trust they will realise and tell their brethren in London that there is something to be learned, and a pleasure to be gathered scientifically in the association we have formed.

Mr. Gordon: As one of the members of the Association outside this district, I feel I cannot leave Portsmouth without adding my meed of praise of the work we have seen. I am quite sure we shall all leave the town, having learned something of the sewage problem. We have seen works which will be a credit to Portsmouth and the engineers concerned, and I would only suggest that all those gentlemen who might have works in view of a smilar character may be fortunate enough to secure contractors who would do such justice to the works as Messrs. Mowlem and Co. had done. I hope also, the engineers who have such works would always arrange their boiler-house so that a spread, such as we have had to-day, might take place there. Coming, however, to the paper, I have learned from Mr. Boulnois that the time at his disposal for it had prevented him entering largely into particulars, and I hope he will supplement the paper by further details. There were two or three questions which I would point out to Mr. Boulnois, that would be useful if he would include them in any further details he might furnish for their minutes. He told us that the fall of the sewers laid down by Mr. Angell was very flat, being only one in 5280. I should be glad to know, for instance, whether the Portsmouth authority have any experience already, and if not, would suggest that if they should shortly have that experience, he should include it in his paper., as to whether the new work

capable of maintaining a continuous flow, would have the effect of making the sewers self-cleansing. There is one other point in reference to the branch sewers; he anticipated that it would be necessary to inaugurate a system of automatic flushing-tanks. If Mr. Boulnois would tell us how it was proposed to supply these tanks it would be useful. In conclusion, I should like to say that we are all very much obliged to the Mayor, Mr. Boulnois, and the authorities for their handsome reception.

Mr. PEREGRINE BIRCH, C.E. (Westminster): Speaking as a visitor and not as a member of this society, I beg to thank you for the opportunity of the visit, and also to extend my thanks to the Corporation, and hope that the contractors had made the lump of money which they so thoroughly deserved.

The PRESIDENT then put the resolution of thanks to Mr. Boulnois, Mr. Harris and Mr. Burt, which was carried with acclamation.

Mr. BOULNOIS thanked them for passing the resolution, and expressed the great pleasure he felt at seeing so large a number of members present. They had had one of the most successful district meetings of the Association, and he felt that the Association of which he was proud to be a member, was gradually and steadily gaining ground throughout the country. The works were not his own. Mr. Harris, Sir Frederick Bramwell's able representative, was there, and he no doubt would make a few remarks. The points which had been raised he would certainly bear in mind. They were very important questions, and with many others would make a very interesting contribution to the 'Minutes of their Proceedings.' Every engineer in every town should try to get the members of the Association to meet and see the works, and give them *in extenso* the whole of the details of these works which he had carried out. They were always valuable, and he personally should always be glad to assist the Association as far as lay in his power.

Mr. H. G. HARRIS said he had little to say. He had been asked no questions. A good deal had been said in praise of Mr. Boulnois, which he thoroughly deserved. He came in just after they (Sir F. Bramwell and himself) did. He did not like to see strange engineers in the place, but he was always good enough to hold his tongue and did not say so. He had done better than that, he had helped them in every direction. All the thanks they had given to him were only thanks that should be given. On his own behalf and on behalf of Sir Frederick Bramwell, he thanked the Association for their great courtesy.

Mr. J. M. BURT in a brief speech could only say he was very much obliged. It had given him very much pleasure to see so many old faces which he had known years before, and whom he had not seen for some time, also to see so many new faces which he hoped many times in future to see again.

Leaving the Town Hall, the Members proceeded in brakes along the Esplanade, by the Canoe Lake, through Eastney Barracks to the Pumping Station, where lunch had been provided by Messrs. Mowlem and Co., contractors for the reservoirs, and which was served over the boiler-house. The Company then drove to the outfall works, and inspected one of the tanks as well as the actual outfall, whither they were conducted by Mr. Burt. On returning to Portsmouth the party drove to the Corporation Stables, which were inspected, and proceeded to the Town Hall works, where Mr. Boulnois read his paper, and the plans and details of the works were examined.

DISTRICT MEETING AT KIDDERMINSTER.

June 11, 1887.

Held in the Municipal Buildings, Kidderminster.

Mr. T. Coulthurst, *Member of Council, in the Chair.*

A letter was read from Mr. Pritchard, asking to be relieved of the duties of Hon. Secretary for the Midland Counties District. On the motion of Mr. J. T. Eayrs, seconded by Mr. Parker, Mr. A. T. Davis, of Stratford-on-Avon, was elected as Hon. District Secretary. A hearty vote of thanks was passed to Mr. Pritchard for his long and valuable services to the Association as District Secretary. The following paper was read and discussed :—

DESCRIPTION OF THE SANITARY WORKS OF KIDDERMINSTER.

By A. Comber, Borough Engineer.

In this paper I propose to give a description of the sanitary works of Kidderminster, but more especially to those that have been carried out since the last District Meeting, held here in November, 1876, as a full description of the works then existing, and the cause of the construction of them, will be found in the paper I then read, in Vol. 4 of the 'Proceedings of the Association.' I shall only refer to them so far as necessary to lead up to them as they now are. The original works were designed and carried out by Mr. Josiah Forster Fairbank, of Westminster, and completed in 1874. Kidderminster is almost equally divided by the river Stour running through it from north to south, the junction of which with the Severn gives the name to the town of Stourport, 4 miles distant.

The area of the borough is 1190 acres, 1150 of which are drained; the staple trade is the manufacture of carpets, and large quantities of dyes are used which are ultimately discharged into the sewer at a very high temperature. The main outfall is of brick, egg-shaped, 4 feet by 2 feet 9 inches, and runs nearly parallel with the river, it is 1252 yards in length, gradient 1 in 800, and varies in depth from 15 feet to 25 feet; the eastern outfall is 2652 yards long, varying from 3 feet by 2 feet to 15 inches circular; the western outfall is 1490 yards in length, size 3 feet 6 inches by 2 feet 6 inches to 18 inches. The latter has a rapid fall during greater part of its length.

The length of branch sewers is about 18 miles, size from 24 to 12-inch pipes. All surface water was conveyed to the sewers. The main sewer discharged into two tanks, and from thence was raised to the farm through an 18-inch main to a small receiving chamber 98 feet above the level of the engine-house. The engines were of the beam type, with bucket and plunger pumps, the storm pumps being two 12-inch centrifugal; the whole of the works including sewage and waterworks were placed under the supervision of myself in January 1874, from the commencement of the regular working the engine. Pumps and boilers were found to be inadequate to perform the work required of them in wet weather, and frequent breakdowns were the result. The boilers, owing to faulty construction, were constantly leaking. The tanks, in times of heavy rain, were soon flooded, and in consequence the sewers were backed up, the sewage finding its way into the cellars of the houses in the low parts. Again, considerable expense and nuisance was caused by the large amount of detritus which deposited in the tanks, and had to be removed by hand, no mechanical means being provided. Frequent complaints were made by myself to the Town Council of the imperfect condition of the existing works, and in June 1877, I was instructed to prepare plans for a new engine-house, pumps, &c., and the same being approved by the Local Government Board, a loan was obtained and the works completed and formally opened in November 1878; from this time the tanks fell into disuse. The new scheme consists of a pair of horizontal condensing engines, cylinders 19 inches diameter, and 3 feet stroke; the pumps, which are placed on the same bedplate as the engines in a line with the cylinders, are driven by spur gearing; they are double-acting, 20 inches diameter and 5 feet stroke, and are together capable of raising 3,800,000 gallons in 24 hours; the

valves are specially adapted for sewage and are easy of access for removal and renewal. The suction-pipes descend into the well under engine-house floor, and the delivery pipes are connected with the air vessel which is between the pumps, from whence the sewage flows downwards into the 18-inch main to the farm; every part of the machinery is in duplicate, and so constructed that the right-hand engine can, if required, work the left-hand pump, or both at the same time, and *vice versâ*. The sewage is passed through a straining grate to take out coarse refuse and then pumped direct to the farm. The indicated horse-power required in ordinary duty is 89·25.

The storm-pumps, which are used in times of flood, are two combined engines and centrifugal pumps, capable of raising 8,640,000 gallons in twenty-four hours. They are placed between the main pumps. The discs are specially adapted for sewage pumping, and there has never been any difficulty caused by them choking since they were first started. The boilers, one of which was fixed in 1875, and the other in 1882, are of the Lancashire type, 28 feet long and 7 feet diameter, with flues 2 feet 9 inches diameter, fitted with Galloway tubes. The last boiler fixed is a steel one. They are worked to a pressure of 80 lbs. The cost of the engine-house, engines, and pumps, exclusive of new boiler, was 4250*l*.

Sewage Farm.

The sewage farm is situated at Upper Mitton, near Stourport, about three miles south from the pumping-station.

The subsoil is new red sandstone of an open and gravelly nature, and comprises a total area of 172 acres, of which, however, 22 acres are unavailable for purification purposes, as they lie too high for the sewage to reach.

The sewage was originally pumped by day only through the rising main, into a small receiving tank, 30 by 20 by 9 feet, on one of the highest portions of the farm, whence it was distributed by means of short lengths of pipes to open carriers, wooden spouts being largely used for the purpose of distribution.

The drainage was effected by a 15-inch main, about 7 feet deep, running diagonally through the land.

There was an open carrier constructed along the base of a long slope, the engineer's idea evidently being that the sewage would flow down over the land, when it would be sufficiently purified to

be taken by means of this carrier to the river! This, of course, was very soon removed. Only about 25 acres were drained with 4-inch pipes 3 feet deep, the gravel over the remainder of the farm being considered sufficiently open and good enough to purify the sewage without underdrainage. 18,000*l.* was spent on the purchase and laying-out of the land.

The farm was originally worked by the Corporation, but finding it to be an annual loss, in 1875 they leased it to Mr. E. H. Crowther at 3*l.* per acre, or a total of 516*l.* per annum.

After the lapse of four or five years, complaints were received from the tenant that, owing to the absence of underdrainage, the land was becoming saturated, and that he was unable to deal with the sewage in the then state of the land. In February 1880, Mr. Pritchard was called in to report on the state of the sewage farm, and he advised that it should be thoroughly underdrained and provided with underground carriers, which, by means of chambers and valves, should be capable of turning the sewage on to any part of the farm below the tank. This scheme, involving a further cost of 3000*l.*, was carried out, and the tenant agreed to pay 5½ per cent. per annum on the outlay, in addition to his ordinary rent. It would, no doubt, have been effectual in removing any cause for complaint if the distribution of the sewage had been properly attended to, but unfortunately, until lately, both the distribution of the sewage and the cultivation of the farm were very much neglected. Now, however, the Corporation have taken the farm into their own hands, and appointed an experienced manager, all cause for complaint has been removed.

Owing to the bad management of the farm, an action was entered by the owner of an adjoining property, claiming 1500*l.* damages and an injunction to restrain the Town Council from using the land for the disposal of sewage. The action was tried before Baron Huddleston, at the last Birmingham assizes, and after a four days' trial, the jury awarded 20*l.* damages. As an appeal on a point of law was pending against the plaintiffs, the matter has been arranged by the Corporation paying costs, and giving an undertaking to conduct the farm so as not to be a nuisance, the plaintiff foregoing the damages awarded and injunction.

Water Supply.

A description of the original scheme for the supply of water (now known as the Upper Well) will be found in my former paper. The bottom of the reservoir was originally formed with puddle, upon which was laid six inches of gravel. This was removed in 1880, as under the influence of light a confervoid growth was developed, to obviate which and facilitate the cleansing of the bottom, asphalte was laid; in 1879 an application was made by the Stourport Local Board for a supply of water from the Kidderminster reservoir, and an arrangement was made to supply them by meter, the charge being 6*d.* per thousand gallons.

In May 1879 an accident occurred to the pump; the reservoir being nearly empty it was absolutely necessary to provide a temporary supply. I had the ground excavated round the well and bore-hole at the sewage pumping station, which had been originally sunk to supply the boilers there. I then placed the steam fire-engine within reach of it, and for six days and nights kept the greater portion of the mains charged, water being supplied by means of carts to the higher portions of the town.

In consequence of this, and of the evident fact that the water supply from the Upper Well alone was becoming inadequate for the increasing requirements of the town, the Council passed a resolution "that the Borough Engineer bring up a scheme and estimate for a new bore-hole at the well near the sewage works, and for alterations of right-hand engine (originally used for sewage pumping) in order to obtain an additional supply (of water)."

I accordingly advised that the bore-hole at the lower pumping station be increased from 3 inches to 9 inches diameter, and sunk to an extra depth of 120 feet, and that the right-hand engine be altered for the purpose of pumping from the well. I also advised that the outside of the well should be puddled, and the wall round it raised to prevent the water overflowing into the tanks; by these arrangements an additional water supply of 648,000 gallons per twenty-four hours would be obtained. This scheme was carried out at a cost of about 300*l.*, and this well was afterwards known as the Lower Well. Both engines were originally used for sewage pumping, and are now used for pumping water from this well.

This Lower Well was an open one without tubing, 10 feet in diameter, the upper part lined with brickwork, passing through

made ground and clay, and backed with two feet thickness clay puddle, which at the bottom, where it met the sandstone rock, was cut three feet below the brickwork into the solid rock. At about 18 feet deep the red sandstone was met with, and the well was carried through this rock, without any steining, to a depth of 30 feet. From the bottom of the well, a bore-hole 10 inches diameter was carried down 300 feet, meeting with an ample supply of water, which, when the pumps are not at work, rises to near the surface of the ground, falling to 20 feet below the surface when they are working; below this level it cannot be reduced by the present engines.

The water was, and still is, pumped direct into the town mains, where it mingles with the water from the Upper Well, at the junction with the Stourport Road.

Before the water from the Lower Well was used, samples were taken, with excellent results, and showing it to be well adapted for potable purposes.

Thus, in the year 1880, Kidderminster was being supplied with water from two wells, the upper and lower, and in order to keep the standpipe at the reservoir charged, so as to give a good supply to the higher portions of the town, it was found necessary to keep both the upper and lower pumps at work during the hours of 8 a.m. and 5 p.m., which has since been increased to almost constant work.

The consumption of water from the two wells last year was 368,257,730 gallons, including 5,937,000 gallons to Stourport, or 1,008,923 gallons in 24 hours, whereas the Upper Well has been previously stated as only being capable of yielding 630,000 gallons in 24 hours; showing that without the Lower Well, a large portion of Kidderminster would be without water.

The author hopes that he has made clear the condition of the Kidderminster sewage and water supply, as it existed from 1880 to 1884, and will now proceed with the account of the epidemic, and describe the details of the Improvement Scheme. This epidemic of typhoid and enteric fever visited the town in the summer of 1884; many letters appeared in the local and Birmingham papers, calling attention to the smells arising from the sewers, and more especially owing to sensational newspaper reports, sentimental feeling was engendered against the use of the Lower Well as a source of water supply.

Analysis had been repeatedly made, and always proved highly

satisfactory, but the use of the Lower Well was discontinued for a short time (from September 21st to October 29th).

This, however, was done more to pamper public feeling, rather than from necessity, as the water, as shown by analysis, was evidently quite pure.

In spite of the discontinuance of this well the epidemic continued to rage, and on September 6th there were over 100 cases of fever in the town, increasing up to November 14th to 1200 cases. The first death from enteric fever occurred on August 25th, and up to November 14th the total number of deaths which occurred was 89.

No definite cause being discovered, the Town Council invited the assistance of the Local Government Board to investigate the matter, and Mr. Franklin Parsons, their medical officer, attended for this purpose. The Council also invited Mr. E. Pritchard, M.I.C.E., to report on the sanitary condition of the town in conjunction with myself.

Dr. Parsons instituted a thorough examination, but at the end was unable to actually state the cause of the epidemic. No fault could be found with the water, and the Lower Well was again brought into use. The intermittent supply was, however, strongly condemned. Serious defects were found in the sewerage, and in the joint report by Mr. Pritchard and myself, the result of our inspection of the sewerage arrangements, both as regards the construction of sewers and house drains, proved them to be most defective, and, in their present condition, positively dangerous to the health of the public, some of the sewers being laid with a reverse fall, allowing the organic matters therein contained to decompose, and evolve deleterious gases.

To this Dr. Parsons adds in his report:—

1. That some of the manholes have bottoms sunk below the invert of the sewer, so as to serve as catch-pits for the retention of putrefying sediments.

2. That from the factories large quantities of heated liquids, the contents of boilers, dye-vats, &c., are run off into the sewers, raising the temperature of the sewage, and thus promoting decomposition, and by displacement and expansion increasing the tension of air in the sewers.

It seems probable, moreover, that the specific contagium of enteric fever, which there is reason to suppose to be a minute living organism, would propagate itself more rapidly in sewage at a temperature approaching that of the human body than in the cold.

3. That in the construction of the sewers no provision has been made for preventing the forcible ascent of air from the main sewer into the branches on higher levels in all parts of the town.

4. That the flushing of the sewers has been defective during the past dry summer. The sewers are planned to carry off surface water as well as sewage, but during the past summer the deficiency of rainfall has doubtless favoured the accumulation of deposit in the drains, and has caused many traps to become unsealed by evaporation of the trapping water. Some of the sewers are flushed by automatic siphon tanks, of which there are three in different parts of the town; others by hose-pipes from hydrants. There is a difficulty in flushing some of the sewers in the higher parts of the town owing to the failure of the water supply at the higher levels.

There is abundant evidence, from the statements of medical men and others, that during the past summer sewer smells have been particularly frequent and overpowering.

5. That the sewers are of comparatively small size. The main sewer in the bottom of the town is an oval brick culvert 4 feet by 2 feet 9 inches diameter, and two other shorter sewers are brick culverts of lesser size, but the others are pipe-sewers of 15 and 12 inches, and a few only 9 inches diameter. The house drains, on the other hand, are 6 inches and sometimes 9 inches in diameter. Without implying that the sewers are too small for the work which they have to do, it must be remarked that the displacement of air caused by the entry of equal volumes of liquid will, in the absence of sufficient openings for relief, cause a greater air-pressure in a small than in a large sewer.

Unfortunately there is no plan of the sewers in the possession of the Town Council, the original plans having, as I was informed, been retained by the former engineer, between whom and the Town Council a disagreement arose. It is stated that in the construction of the sewers considerable deviations were made from the plans as sanctioned by the Local Government Board, and that much of the work was badly executed.

The sewers are known not to be water-tight; there is some leakage of subsoil water into the brick culverts, and the pipe sewers are jointed only with clay.

Many of the house drains were found to be untrapped, and where traps had been used, they were the bell (generally found with the bell off) or the D or Liverpool pattern. These cannot be jointed directly with the drain pipe, but must be set in a brick socket

or catch-pit, and this setting was found very often to be badly done.

The midden steads were of enormous size, 8 feet by 6 feet by 3 feet below ground being a common size, often in confined situations close to houses.

The frequency of piggeries adjoining dwellings were also noted and strongly condemned.

If there was any pollution of the water it was certainly not at the source, but may have been occasioned in the following manner:—

As has been previously described, the water-main descending from the Upper Well enters the town at its lowest point, and thence the branches ascend to supply the various parts of the town, high and low. Hence, if the amount of water entering the main be insufficient to supply the demands, the water will not reach the extremities of the higher branches, but will stand at a level fluctuating every minute, according to the amount of water drawn from the pipes as compared with that entering them. When the column of water falls in the pipes, air is sucked in to supply the vacuum through any orifice that may be open. This air, owing to the defective sewers, must have been constantly vitiated near many taps. The closets are generally furnished with the two-gallon flush cisterns, so that in the parts where the supply was intermittent, the closet would probably be used many times before there was a supply for flushing out, thus any foul gases arising from the excreta would be drawn into the mains through the ball-valves.

On September the 23rd, Mr. Pritchard and myself were directed to report on the general sanitary arrangements and water supply. Our report on September the 27th recommended as follows:—

1. The tubing of the lower well, as a temporary measure.
2. The construction of another well with additional pumping power.
3. The covering of the present reservoirs, and the construction of a high-level service reservoir.
4. That the supply of water be constant, and no direct connections between the distributing pipes and water-closets be permitted.
5. The better ventilation of the sewers.
6. The relaying of such sewers as have not a proper fall.
7. The filling in of the catch-pits in the sewers.
8. The disconnection from the sewers and the ventilation of the house drains.

9. The construction of flap-valves to prevent sewer gas rising to the higher parts of the town.

10. The diversion of rainfall and manufacturing refuse from the sewers.

11. Additional flushing chambers.

12. The abolition of midden privies and the substitution of self-acting trough closets and covered dry receptacles for ashes.

13. The prohibition of pig keeping in the populous parts of the borough.

14. The erection of a public abattoir and the closing of objectionable private slaughter-houses.

15. The closing of houses unfit for habitation.

Dr. Parsons adds :—

These recommendations appear to meet most of the requirements which the sanitary state of the town demands.

The ventilation of the sewers by gratings in the centre of the road has been proceeded with ; 153 such gratings had been inserted up to November 8th, and others were being put in at the rate of ten a day.

The Town Council have lately engaged an Assistant Inspector of Nuisances, whose duty it is to see to the proper construction of drains and other new works.

The tubing of the Lower Well was a matter of some difficulty.

A wrought-iron flush-jointed screwed tube 50 feet long was obtained, to the bottom of which was fastened an ordinary hydraulic cup leather. Above this were placed encircling the tube, three Hancock round rubber rings, above which, allowing a little play for the rubber rings, was wound some gaskin, saturated with melted tallow wrapped in a slightly taper form. When this was lowered into the bore-hole it was found to carry its own weight, about 6 feet above the point it had to reach. It was gently forced into its place, and a 2-foot cast-iron pipe was attached to the top of bore-pipe, to which by means of cast-iron junction pipes, the existing suction pipes were connected. All joints were faced in the lathe or planing machine, and made quite tight.

To enable the concrete being properly applied between the outside of the tube and the bore-hole it was necessary to prevent the water coming up from below so that the men could work on the bottom of the well.

Many devices were tried without success, the pressure of the water being great.

I eventually hit upon the following plan:—

A cylindrical block of special "india" rubber was made, which was secured to a 1-inch iron rod with a flange on its end. This rod with the rubber attached, was placed through a strong 1¼-inch pipe, which also had a flanged end, and having been made a little longer than the pipe, the top of the 1-inch rod protruding through the 1-inch pipe was provided with a screwed end with nut and thick washer.

The whole was then lowered through the bore-pipe down into the bore-hole, so that the rubber block was just below the cup leather on the bore-pipe; the nut on the top of the rod carrying the rubber block was then screwed up, thus raising the rod and compressing and expanding the rubber; by this means the water was prevented from ascending. The space between the bore-pipe and the sides of the bore-hole was then filled in with specially prepared concrete as also was the space in the well surrounding the 2-foot cast-iron pipe and suction-pipes, and after the whole had set, the india-rubber block was released from the screw pressure and withdrawn.

Thus the well and bore-hole were so protected as to be impermeable to any surrounding moisture, and prevented the possibility of contamination of the water supply at its sources.

Unfortunately the Corporation did not receive Dr. Parsons' report until the end of January, and although Mr. Pritchard and myself had presented our report for the improvement of the sewage and water supply, with plans and estimates a month earlier, nothing was done by the Council until after they had considered Dr. Parsons' report in conjunction with the engineers' scheme.

However, it was found that Dr. Parsons approved of this scheme, and recommended its being carried out. It may be briefly stated as follows:—

Water.

1. A new well at the upper pumping station with additional engine-house and additional boiler and stack.

2. The construction of a high-level service reservoir, about three-quarters of a mile from the pumping station, to which the water from the above should be pumped through a 15-inch rising main.

This to be constructed at once to enable the town to have the extra pressure from the old well and pumps until the new well should be sunk.

3. An additional connection by means of a 9-inch main down

Bewdley Road to the western part of the town to relieve the single main from the existing reservoir, and to facilitate the distribution by diminishing friction.

Sewerage.

1. The taking up of the existing sewer and the construction of a new one in Park Lane, with a fall the reverse of the existing sewer, so as to intercept the greater portion of the sewage from the western district, namely, from Sutton Common, the Woodfield estate, and a portion of Blakebrook, which the existing sewer could not command.

2. Other existing sewers, representing a length of 4220 yards, varying in size from 24 inches diameter to 12 inches diameter, to be taken up and relaid.

3. The construction of manholes and ventilating shafts through the town.

4. All sumps of existing manholes to be filled up.

5. The construction of metal shafts in the higher portions of the town to be attached to buildings to facilitate ventilation.

6. The construction of fifty-six automatic flushing chambers in various parts of the town.

7. The removal of surface or storm-water where possible, the existing sewers not being of sufficient capacity to carry away both.

8. An additional boiler at the new pumping station and new chimney-shaft.

9. Improvements in house connections.

The estimated expenditure of the above was 25,000*l.*

The Council approved the above, and applied to the Local Government Board for power to borrow the money, and on the 14th April an inquiry was held, and in July the scheme received the approval of the Local Government Board. It was, however, decided not to construct the new well at once, but to continue using the other wells so long as they were sufficient for the demands of the town.

Tenders were immediately advertised for contracts, and the works commenced.

The whole of the contracts were carried out by Mr. G. Law, of Kidderminster.

The first portion of the improvement scheme carried out was the construction of the flushing chambers. These are constructed of brickwork, backed by 1 foot thickness of clay puddle, the bottom

being formed of 9 inches of concrete, and the whole of the interior rendered 3 feet 4 inches thick with Portland cement.

The flushing siphon used was automatic, of Messrs. Doulton's manufacture; various sizes being used, according to the size of sewer to be flushed, the general size for the smaller sewers discharging with a 3-foot 6-inch head of water and 6-inch outlet pipe; the chamber supplying this size of siphon was 8 feet long by 4 feet wide, the total quantity discharging at each flush amounting to about 600 gallons, the frequency of the flush being regulated by a tap provided to every connection made from the water main to each chamber. The tanks ordinarily are regulated to discharge once a day.

The siphons used for the large-sized sewers discharge with a 3 feet head of water, and have an 8-inch outlet, the chamber containing each one being 10 feet long and 5 feet broad, discharging about 900 gallons at each flush.

Special precautions are taken to prevent the reflux of air from the flushing tanks into the water mains by means of the service-pipe supplying:—

1. By the trapping of the discharge pipe from the siphon into the sewer.

2. By two back-pressure taps on the water pipe supplying the chamber.

3. By the delivery end of the water pipe being bent into a V shape so as to form a water seal.

4. By the flushing chamber being ventilated. Altogether there are forty-seven small chambers and six large ones.

In 1886 735,000 gallons of water were used for flushing from the water carts, and 19,381,000 from the tanks, or a total of 20,116,000 gallons.

Contract No. 4 was the first alteration of the sewerage system, and comprised the substitution of a 15-inch for a 12-inch pipe in Birmingham Road to receive two 12-inch pipe sewers taken up and relaid in Chester Road, and also the sewage from the northern part of Hurcott Road.

The pipes had all deep sockets and were jointed with tar cord and cement.

In this district the roots of trees were found to have penetrated the joints of the existing pipes, almost entirely.

The greater number of the pipes were open-jointed, and they had evidently been laid without regard to line or level, a large

number being taken out of the trench three parts full of sediment. None of the connections had been properly made, the drain pipe having been simply poked into the main.

The new manholes were built of brown Staffordshire bricks set in cement, the inverts being formed with half-pipes.

The sumpholes were formed with 9-inch vertical pipes with special ventilating covers, Batten's patent.

Valves were inserted in some of the manholes to localise ventilation.

Contract No. 3.

The brick culvert from the pumping station to Park Lane, and the pipe sewer along Park Lane to Park Butts was the most extensive improvement in the sewerage scheme, as it diverted the greater part of the western district from the existing main outfall. It involved the construction of an egg-shaped brick sewer 4 feet by 2 feet 8 inches, 322 yards in length, set in cement mortar passing underneath the arm of the Stour, and also under the Stafford and Worcester canal, and terminating in Park Lane. A very large quantity of water was encountered from the commencement of this work, some of the springs tapped being as thick as a man's arm, to get rid of which a 9-inch sub-drain was laid from the pumping station to and along Park Lane as far as its junction with Park Street, thence forward a 6-inch pipe was found sufficient. This water was utilised to supply the condensers of the pumping engines, a tank being built for this purpose in the engine-house yard.

To enable the sewer to be laid under the river the water was run off and diverted down another branch of the river, the space between the top of the brickwork and the bed of the river was filled up with concrete and clay puddle. The material passed through between the pumping station and the river was chiefly made ground, and necessitated the bottom of the trench being formed with concrete to receive the brickwork. After leaving the river the strata soon changed into new red sandstone which continued along Park Lane to about 80 yards below Park Street, where it ceased, and in its place running sand was met with which continued for some 250 yards, when the sandstone again cropped out and continued to the termination.

A low heading was driven under the canal of just sufficient

height to enable the sewer to be laid up to the springing level of the top arch, after which the water was run off and the rock intervening between the bed of the canal and the top of the heading was quickly broken through, and the culvert completed, the water being in the canal ready for traffic in about 10 hours.

The invert of the brick culvert was formed with blocks moulded on the ground with radiated bricks set in cement, each block being about 18 inches in length.

Throughout the sandstone the sewer was laid on headings, average 30 feet deep, boring rods painted with luminous paint were used in the long headings which were found to be effective as long as they were kept clean.

From the termination of the brick culvert to Park Street, 24-inch pipes were used, upright pipes being brought up at each shaft to facilitate future connections.

From Park Street to Park Butts earthenware pipes 21 inches diameter were used with deep sockets jointed with tar gaskin and cement. Through the running sand the pipes were surrounded with about 1 foot thickness of cement concrete. A travelling steam crane was used to lift the material from the trenches.

The condition of the existing 18-inch pipes as taken up was fearful. The new pipe sewer averaging about 18 feet deep was laid down along the line of the existing sewer, which was taken up and the pipes were found to be almost choked with black sediment, many joints were found in which the spigot and socket were several inches apart, and no attention had been paid to level, very many portions of the sewer having a reverse fall. The photographs on the table were taken of the pipes as removed, from which some idea may be gathered of the condition in which they were found.

The next sewer reconstructed was in Mill Street, where the existing pipes were taken up in quite as filthy a state as in Park Lane. In one case, a length of 15-inch pipes had been laid, with an 18-inch pipe sewer on each side of it.

Through the Bull Ring, Swan Street, High Street and Coventry Street, a surface water drain was laid, to which all the gullies were connected, taking the rain-water direct into the river, the outlet being provided with a self-acting flap valve to prevent back-water.

In Hall Street, Dudley Street and the Horse Fair, the gullies were connected with an old disused brick culvert, 2 feet diameter, also conveying the flood waters direct into the river.

Kidderminster is very liable to floods, and in May 1886 the

river rose to such a height, that it found its way into the streets, Mill Street being 4 feet 6 inches deep in water. The photographs show the state of affairs there.

The above comprise the works of improvement in the sewerage, but other defective sewers are still being replaced by new ones.

Improvements in the Water Supply.

As previously stated, the recommendations of the engineers were :—

1. New well and pumping machinery.
2. New reservoir (high level).
3. Additional main.

The Corporation, however, decided for the present to proceed only with the execution of the two latter improvements and economise their consumption of water so as to, if possible, dispense with the necessity for the new well and engines, it being believed, that as the Lower Well had not been condemned, the present supply would be sufficient if additional pressure were provided.

The reservoir was commenced in August 1885, but owing to the severe winter, was not completed until September 1886.

It is a covered reservoir, square in plan, measuring 145 feet each way, and it has about 15 feet depth of water when filled, the capacity being nearly 2,000,000 gallons, or 4 days' supply at 20 gallons a head. It is formed by partial excavation, and partial embankment. The walls are of brindled bricks in cement mortar, backed with clay puddle. The bottom is formed of concrete, on the top of which is laid 18 inches of puddle, all pugged in a mill, the floor being formed with blue brick on edge, set in a cement bed $\frac{1}{2}$ inch thick, and grouted with cement.

The roof is supported by 72 cast-iron columns, on brick and stone bases, and is formed by rolled iron girders 20 inches by 7 inches, carrying cross girders 12 inches by 6 inches, which in their turn support concrete arches 1 foot thick at the crown, the soffit being rendered in cement. Overlying the concrete for a depth of 2 feet is placed ordinary soil, and it is intended to lay this out in ornamental beds and walks, to approach which a flight of steps of blue bricks has been constructed.

The ventilation is obtained by 9 cast-iron ventilators, with buckets inside to prevent contamination

The necessity of having the reservoir covered in would appear palpable from the constant growth of conferva in the old reservoir, due to the action of light and heat upon water from the new red sandstone. In fact, to use the engineer's words at the opening ceremony, "unless water from the new red sandstone formation is protected from light and heat, you must have from the very nature of the water deteriorating influences going on, in other words, the artificial reservoir should be made as nearly as possible, a copy of the natural reservoir, from which the water is derived. The elevation of the new reservoir above the old one is 43 feet."

The water is supplied from the existing wells, the pumping main 15 inches diameter having been laid along a new road from the upper pumping station to the new reservoir.

This main is connected with the rising main to the old reservoir with the 12-inch old supply main to the town, and the valves are so arranged that pumping can take place either from the upper or lower well into the new reservoir, reflux valves being provided to take the pressure off the pumps. There are three air valves at suitable points on the rising main. To enable the engine-driver to tell when the reservoir is full, a 1-inch pipe has been laid from the reservoir to the engine-room, and will be so arranged that when the water attains a fixed level it will ring an electric bell, which shall warn the driver that the reservoir is full.

In 1885, 156,126,500 gallons were pumped from the Upper Station, and 121,419,870 gallons from the Lower, making a total of 277,546,370 gallons or an average of about 30 gallons per head per day.

In 1886, 192,031,520 gallons were pumped from the Upper Station, and 176,226,210 from the Lower, total 368,257,730 gallons, or deducting 5,937,000 gallons supplied to Stourport, and 20,116,000 used for flushing, an average of 36 gallons per head per day. This increase may be due to the fact that the Lower Well was stopped for some time in 1885 and also that in 1886 more water was used in the higher parts of the town during the latter end of the year when the new reservoir was at work.

The death rate for 1883 was 17·78 per 1000; in 1884, the year of the epidemic, 19·64; in 1885, 20 per 1000, and in 1886, 17·8 per 1000, showing a considerable improvement since the sanitary alterations, whether due to them or not.

In January 1886 it was found that there was a leakage from the bore-hole at the Lower Well when the pumps were standing, the

newspapers were again to the fore and a scare created; in consequence of this a third visit was paid to the town by Dr. Parsons, who was accompanied by Mr. Arnold Taylor, Engineering Inspector of the Local Government Board. I do not think the details of what was done in this case are of sufficient interest for this paper, suffice it to say that the Inspectors in their Report say:—

"We see no reason to connect the cases of fever which have occurred in 1885 with the use of the water in the Lower Well, nor do we believe that there is any present danger from its use."

It may now be stated what has been done to put right the defects of the house drains. In March 1885, Mr. Cowderoy, the present Sanitary Inspector, was appointed, and through his vigilance and efforts nearly all the bad sanitary arrangements have been corrected. The system adopted I propose to give in a short supplemental paper.

DISCUSSION.

Mr. Comber: I should like to say a few words as to the sanitary works which have been carried out. I had intended preparing a short paper explanatory of this department, and went to my office early this morning to do so, but as soon as I reached town I found there had been a burst of a portion of our water mains, and we had to hasten to get the damage repaired. My description will therefore be short and verbal. The system we have adopted in the borough is this: all the house drains have, or are in process of being trapped with earthenware gullies, with intercepting traps between the street sewers and the house drainage, with air inlets and ventilating shafts. We are dispensing altogether with the old-fashioned Liverpool system. The water-closets are fitted up with automatic siphon flushing cisterns, of various sizes, and holding from 4 to 30 gallons each. All the sink drains have been disconnected from the sewers. That was one of the things we had to fight so strongly against during the typhoid epidemic. Most of the sink drains were connected directly to the sewers, and the sewer gas was consequently brought directly into the houses. All that has now been altered, and now we have a constant current of air passing through the house drainage by means of the air inlets and ventilating shafts. We, however, still have a considerable number of the old-fashioned ashpits and middens left in the borough. These, however, we have considerably reduced in size; and instead of their

being emptied, as in former years, once in each year, they are now emptied with the greatest regularity from eight to twelve times in the year. The night soil has been carted to a depôt on the Worcester road, where it was treated in a chemical manner; but that has now been given up, and so far as the Corporation are concerned we do not treat with the night soil. It is now carted away to market-gardens in the district, while the ashes from the dry ashpits is removed to boggy land, and is so disposed of. The Corporation in that way get rid of the whole of the refuse, and no complaints are made from any quarter. I shall be very pleased to answer any questions which any member would wish to ask. Our outstanding debt is 148,983*l.* and that has been spent upon sanitary works, of course including our water supply. Before any discussion is entered upon, I am told that we are to visit the sewage farm and the pumping stations. You will then be able to see the state of the farm for yourself, and also the effluent. I have the analysis here of Dr. Hill, Medical Officer of Health for Birmingham, and also one by our borough analyst, and they each point to the remarkable purity of the effluent. Dr. Hill declares that it is not only clear, bright and colourless, but also vastly superior to much of the water frequently obtained from town wells. I have myself frequently drank the effluent, and so have many others who have visited the farm.

The Chairman: Time is now very short for discussion, but I cannot fail to express the very great pleasure we have all experienced in visiting the various works to-day. We have seen the admirable sewage farm, which reflects the greatest possible credit upon the Corporation of this borough, and especially upon the borough engineer, Mr. Comber, and the bailiff, Mr. Tough. As far as my experience goes, and it has been a lengthened and varied one, I do not hesitate to say that the farm at Stourport is one of the best I have ever seen. I will not however enlarge upon this question myself, but will call upon a member of our Association, who has had far more experience than any other member present, Lieut.-Colonel Jones, to express his views upon all we have seen.

Lieut.-Colonel Jones, V.C.: It has given me very great pleasure to come to Kidderminster for the first time in my life, and to have seen all that has been brought under our notice to-day. You can scarcely expect me to give a definite opinion upon the effluent I have seen to-day at the sewage farm. Concerning the farm, I cannot help saying that Kidderminster is very fortunate in having

secured such a bailiff as Mr. Tough. He is the brother of one of the most experienced and practical farmers who has devoted himself to the question of the disposal of sewage. He has taken a most intelligent view of the whole question, and it is evident that the Kidderminster bailiff has become a thorough master of his work, as we have seen by the appearance of the farm to-day. Fifteen years ago people thought a great fortune was to be made out of the sewage of our great towns. There is no doubt great value in the sewage, chemically estimated, much of which is wasted in many districts, but the great difficulty has been all along to make much out of it. One of the greatest difficulties has been, in every place, that we have had too much water to contend with. We have had to deal from time to time with vast quantities of rain-water, and all have now come to recognise the importance of what I advocated fifteen years ago—a separate system for dealing with the water. It has been the fashion in the past to let the water shift for itself, but slowly it is being seen that if we are to deal with the question of the utilisation of sewage in a satisfactory manner, we shall have to adopt a separate system for the surface water. All sorts of things have been drained into our town sewers, and it is little short of a farce to expect them to do this double duty in a satisfactory manner. At the meeting to which I have already referred, I was asked, "Are we to have a distinct and separate system for dealing with the storm water?" and I answered that if the work was to be carried out in a satisfactory manner that would be necessary. Mr. Isaac Shone, then a member of the Corporation at Wrexham, spoke at the meeting, and with his great experience in these matters, he applied himself to the development of the ideas which were then thrown out, and the result was the definite system which he promulgated. It has been applied in many towns and with satisfactory results. I am satisfied that Mr. Comber has done all that could be accomplished under local conditions, to make the work as perfect and as complete as possible. He has here, as others have elsewhere, the difficult question of dealing with the storm and rain water, all running into the town sewers; but he has one thing which is decidedly in his favour, and that is, he has a farm, the land of which is most excellent land for the purpose, and is admirably adapted for dealing with the sewage on the principle of broad irrigation adopted here. Of course, when you have a heavy rainfall you are reduced to the necessity of pumping it away into the river, and no doubt in doing that, which is indispensably

necessary, you run certain risks with regard to river pollution. In these matters, the great thing we have to do is to deal with a reasonable amount of water, and to purify it as well as it is possible to do so. I was very pleased with the appearance of all the growing crops on the farm. Reference was made in the paper to the popular sentiment raised about the lower well. It is not wise for us to be too much moved by public sentiment in these matters. There can be no doubt that the situation of the lower well, being so close to the sewage pumping station, is not all that could be desired; but having regard to the very ingenious method of concreting the outside of the bore, which has been so clearly explained by Mr. Comber, and obtaining the water from a bore of over 300 feet deep, there is not the slightest fear of any contamination, and you could thus afford to disregard the sentimental views which might have been expressed. One of the great works which has been done by the surveyor has been the opening up of so many ventilating shafts in the town. In towns which are always thickly populated, this is necessary, for unless you can relieve the sewers, you are bound to have sewer gas forced into the houses, attended by serious consequences. Of course, in the country the case is different, and the more you let the fresh air come in contact with the sewage, the better will it be. The same remark applies to the distribution of the sewage on the farm. Here the sewage is conveyed over the farm by underground pipes to an unnecessary extent. The farm is far removed from a town, and when in the open country, the more you let the sewage come in contact with the fresh air the better. I will not detain you any longer. I am pleased to have been here, and to have seen the progress which is being made in sanitary works in Kidderminster, and we are all very much indebted to the very energetic borough surveyor for all the excellent arrangements he has made for this meeting.

The CHAIRMAN: I regret that the discussion must be so much curtailed for want of time, for I always feel that full and free discussion on the various points raised is one of the attractive features of our meetings. I recognise, as Colonel Jones has, that vast improvements have of late years been carried out in Kidderminster, and I have been very much struck with the condition of the sewage farm. I have had, as some of you know, something to do in that branch of sanitary science, and I have no hesitation in saying that the farm which we have seen to-day at Stourport is the best of that kind I have ever seen. I have never before seen a sewage farm carried on on the system of broad irrigation as this one is, so free from a nuisance;

and I cannot conceive that in its present state anything more than a sentimental objection can be raised to the working of the farm.

Mr. J. Parker: It is a regrettable fact that we have not more time to go into the details which have been raised in the admirable paper read by Mr. Comber. Many of the points raised are of vast importance, not only to the borough of Kidderminster, but to numerous other communities. I do think that in thanking Mr. Comber for his admirable paper, we may also congratulate him upon the excellent state of all the sanitary works connected with the borough. The town seems to possess a capital water supply; it now has a good and efficient system of sewerage, and the sewage farm is conducted in such a manner as I have never seen excelled in my life. I have seen many farms carried out on the broad irrigation, but I have never seen one so free from anything which could be termed a nuisance. Of course, sentimental objections can be raised to almost everything which might be done; but we are not to be too much influenced by sentimental objections, and that is all I am convinced which can be raised to the working of this farm. The borough is in possession of the triple blessings—good water, good drainage, and as a natural result of these—an empty infectious hospital.

Mr. Holdsworth: I can assure you, gentlemen, it is very gratifying to me, as Chairman of the Drainage and Waterworks Committee, to hear your valuable testimony to the condition of our works in this borough, and especially with regard to the sewage farm. You know we have very recently had to deal with a number of sentimental people, and our borough surveyor has told you in his paper what was the result of the action brought against us. It is most encouraging to listen to what you have had to say as to the condition of the sewage farm, and those observations will undoubtedly stimulate us to increased exertions, as we have an intense desire to so farm it as not to be the slightest nuisance to any one living in its vicinity. We have very recently been reminded by one of the greatest living men in England that this country is to a great extent what she now is because of her municipal institutions, and it is true that the success or failure of almost every town depends upon the character of the municipal institutions governing the place. I am delighted as a member of our Corporation to welcome the members of this important Association to this town, knowing as we all do that the Association is composed of a body of gentlemen who are devoting their lives to the study and application of sanitary and engineering science. I hope

that the result of this meeting will not only be beneficial to the members of this Association, but also to the borough of Kidderminster. This Corporation, as Mr. Comber has told you, has spent an enormous sum of money in sanitary works, and I can assure you we are exceedingly desirous to keep the town as healthy as we possibly can.

The CHAIRMAN: We are very much gratified at the encouraging words which have just been expressed. Without the assistance of Corporations, this Association could not hope to do much good. I am sure the members of this Association are ever animated by the desire expressed by the grandfather of sanitary science, Mr. E. Chadwick, who declared that they were benefactors to the country who could reduce the percentage of mortality in any community, and that is the grand aim of our lives. We all acknowledge that England stands pre-eminent in the work of sanitary reform, and we desire that she should ever maintain that proud position.

On the motion of the Chairman, seconded by Mr. Parker, a hearty vote of thanks was tendered to Mr. Comber for his admirable paper, and for all the arrangements he had made for that day's meeting. On the walls of the Council Chamber and on the tables were exhibited diagrams showing various sections of the sewage works, the geological formation of the district, views of the effects of the great flood in the town on May 14th, 1886, and other interesting objects of the district.

Before commencing the business of the day, the Members paid a visit to the extensive carpet works of Messrs. E. Morton and Sons, being courteously received by the Mayor of Kidderminster, Mr. T. Tempest-Radford, the senior partner in the Firm. From here the Members visited the works of Messrs. John Brinton and Company, Limited; first examined the 1000 *indicated horse-power horizontal engine "Hercules," and then visited the departments specially set apart for spinning the wool, and also the various mills where the manufacture of Brussels and tapestry carpets was carried on.*

After the discussion following Mr. Comber's paper, the Members proceeded in waggonettes to the Sewage Farm at Stourport, and inspected the receiving and distributing tanks. On the return journey the infectious hospital was inspected. The upper and lower wells were also visited, but time would not permit of a visit to the new reservoir.

The Members afterwards dined together at the Lion Hotel, the Mayor of Kidderminster, Mr. Alderman T. Tempest-Radford, presiding. A number of toasts were proposed and responded to.

ANALYSIS.

PUBLIC ANALYST'S LABORATORY,
10 VICTORIA STREET, WOLVERHAMPTON, 18*th February*, 1887.

CERTIFICATE TO THE TOWN COUNCIL, KIDDERMINSTER.

SAMPLES OF SEWAGE AND EFFLUENTS TAKEN AT MITTON ON THE 10TH INST.

	Whole sewage taken from tank.	Effluent chamber at farmhouse.	Effluent chamber at bullocks' hole.	Night sewage given by Mr. Comber.
	grns. per gal.	grns. per gal.	grns. per gal.	grns. per gal.
Total solids dried at 212° F.	115·50	70·00	53·20	30·10
Volatile solids	42·70	7·00	6·30	8·40
Suspended matters	38·92	None	None	1·82
„ organic	31·36	..	..	1·54
„ minerals	7·56	..	..	0·28
Free and saline ammonia ..	1·071	0·009	0·025	0·146
Albuminoid ammonia	1·461	0·013	0·017	0·034
Oxygen absorbed in 4 hours at 80° F.	5·852	0·104	0·157	0·177
Combined chlorine	6·44	5·67	5·46	3·08
Nitrogen as nitrates	..	1·00	0·87	0·54
Phosphoric acid	0·915	Slight trace.	Slight trace.	Heavy traces.
Smell cold	Faint	None	None	None
„ when heated to 100° F.	Slight	..	..	Slightly earthy

(Signed) E. W. T. JONES, F.I.C., *Borough Analyst.*

RESULTS OF ANALYSES EXPRESSED IN PARTS PER 100,000.

1887.	Description.	Total Solid Matter.	Free Ammonia.	Organic Ammonia.	Nitrogen as nitrates.	Phosphoric Acid.	Chlorine.	Suspended matter.		
								Organic.	Mineral.	Total.
Feb. 3	Raw sewage taken at the pumping station, Kidderminster *	107·40	1·200	0·375	Trace	Trace	15·6	33·8	11·9	45·7
Feb. 3	Effluent discharged from sewage farm into canal †	73·20	0·020	0·028	1·76	None	6·9	None	None	None

REMARKS: * Appearance turbid, reaction very slightly alkaline. Colour purplish red. Odour slight, not offensive.
† Appearance clear and bright, reaction very slightly alkaline. Colour none. Odour none.

RESULTS OF ANALYSES EXPRESSED IN PARTS PER 100.

1887.	Description.	Appearance.	Moisture.	Organic Matter.
Feb. 3	Sand from canal bank under drain pipe ..	Bright red	14·17	0·50
„	Sand from other part of the bank	do.	16·80	1·13
„	Soil from hole in field at Newtown near Mr. Brown's	Darker red	3·63	1·28
„	Soil from hole in field near turnpike road and Mr. Brown's house	Red	9·25	0·78

DISTRICT MEETING AT BOLTON.

July 2nd, 1887.

Held at the Town Hall, Bolton.

Mr. J. Lobley, *President, in the Chair.*

By kind permission of the Mayor, the Members assembled in the Mayor's Dining Room in the Town Hall.

DESCRIPTION OF THE BOLTON SEWAGE WORKS.

By J. Proctor, M. Inst. C.E., Bolton.

Much attention has of late years been devoted by municipal and other authorities to the necessity of rendering the rivers and streams of the county free from sewage pollution, and it will be admitted that the several Committees of the Bolton Corporation have not been unmindful of their duty in this respect, as they were amongst the first to commence works for the interception of the sewage, including those necessary for its defecation.

An agreement has been entered into by the Corporation, as representing the municipal borough, and the rural sanitary authority, as representing most of the other townships within the Bolton watershed, whereby the Corporation construct works and deal with the sewage upon such terms as will be mutually beneficial.

The volume of sewage requiring to be treated varies at the different periods of day and night, but it may be taken to be about 4,000,000 gallons per day of twenty-four hours.

As these particulars are prepared with special reference to the opening of the Hacken Outfall Works, on the 18th October, 1886, by his worship the Mayor (Alderman Thomas Fletcher), the author has not attempted to describe any elaborate details of the sewers, or the general sewerage arrangements of the borough, but has

limited the description to the Precipitation Works at Burnden and Hacken, with slight reference to the principal intercepting sewers and their connections.

Topographically the borough has three watersheds, namely, the Croal, which embraces the heart of the borough to the extent of 1627 acres, and the townships of Heaton, Rumworth, and Lostock; the Tonge, including the eastern and northern portions of the borough, having an area of 358 acres, and the townships of Darcy Lever, Breightmet, Tonge, Sharples, and Halliwell; and Jenny Beck, which includes 193 acres of the southern portion of the borough and portions of the townships of Great Lever, Middle Hulton, and Over Hulton.

Intercepting sewers of sufficient capacity to meet the requirements of these watersheds have been laid by the Corporation along the valley lines within the borough, and as close to the rivers and streams as practicable.

The Croal intercepting sewer discharges at the Burnden Sewage Works from an oviform sewer of 4 feet by 2 feet 8 inches, and is reduced as required along the route to a section of 24 inches diameter at the borough boundary, Blackshaw Lane, with a total length of 3700 yards. The rural sanitary authority have continued this sewer to Deane Clough and Rumworth, and contemplate extending it through the townships of Heaton and Lostock.

The Tonge intercepting sewer forms a junction with the main outfall sewer, a little below the confluence of the river Tonge with the river Croal, near Hacken Lane, in Darcy Lever, and traverses the Tonge Valley and Astley Brook, to the north end of Raglan Street, Halliwell; its diameter decreases from 24 inches at the outlet to 12 inches at the commencement, having a total length of 5530 yards.

The Jenny Beck intercepting sewer discharges into the main outfall sewer, near Burnden Bleach Works, and follows the valley line to Adelaide Street, thence along that street and St. Helens Road to the railway crossing, at which point a connection will be made with the sewers of the rural sanitary authority now laid in the townships of Over and Middle Hulton. Total length of sewer laid by the Corporation is 3900 yards.

The main outfall sewer runs along the valley of the Croal from the Hacken Outfall Works to the Burnden Works, at which point t joins the catch-pit of the Croal sewer, and receives in its course

the sewage from the Tonge and Jenny Beck sewers. Its section at the point of outlet is 6 feet by 4 feet, and the discharging power equal to 50,000,000 gallons per day of twenty-four hours, or of more than sufficient capacity for a population three times the number requiring to be accommodated at present, upon the water-shed within the environment of the scheme.

Burnden Works.

The Burnden Works were constructed in the year 1870, for the purpose of dealing with the sewage from the Croal intercepting sewer, then laid between Burnden and Great Bridge, Chorley Street; they are situate on the west bank of the Croal, near Rose-hill, and consist of six tanks averaging 5½ feet deep, with a total capacity of 400,000 gallons. The buildings consist of one block, 100 feet by 60 feet, cellared throughout, boiler-house, and other sheds, with a chimney-shaft 150 feet high: these buildings were originally designed under the advice of the A B C Company, for the reception of drying-floors, upon which the mud from the tanks was dried, partly by the exhaust steam and partly by the gases from the boiler fire; this was discontinued, as the dried mud fell in value from 5*l.* to 5*s.*, after which the arrangements with the A B C Company were brought to an early termination. The surplus space in the building has been used for the manufacture of cinder-sifters and other timber appliances, required in large numbers by the Scavenging and Sewage Department. The boiler is a double-flued Lancashire boiler, 27 feet by 8 feet, fitted with modern appliances, and drives a high-pressure horizontal engine, having cylinder 18 inches diameter and 30 inches stroke, being in excess of the power required to work the mud pumps, lime agitators, sawing, planing, and other joiners' machinery.

In consequence of the buildings and machinery then existing at these works, it was decided to utilise them for the preparation and application of lime or other precipitant for the new works at the Hacken, instead of duplicating the machinery at that place, involving a large outlay upon capital account, in addition to a heavy fixed charge for a second staff of workmen. Such alterations to the machinery and mixing pits as were deemed necessary have been made, a new catch-pit, 20 feet long and 10 feet wide, has been constructed, with the requisite breakwater, sluice, gauge, screen, and other apparatus, by means of which the flow of sewage

to both Burnden and Hacken can be computed, as the depth flowing over the gauge may be seen at once upon the graduated plate affixed to the side of the pit.

The lime is stored in the cellar beneath the main building, where it is fallen or reduced to a powder, whence it is conveyed to a hopper containing an archimedean screw, the speed being regulated for delivering automatically a fixed quantity of lime into a rotary screen, through which the powdered lime passes to the elevator, the larger particles being rejected and conveyed by a small elevator to another situation to be refallen, and is raised 20 feet by means of the chain buckets, finally discharging into a cast-iron cistern, where it is met by a regulated spray of water supplied from a large iron cistern overhead, and thence through iron pipes to the bottom of one of the mixing pits, to be agitated by means of a rotary shaft with projecting arms; the milk of lime then overflows through a fine sieve, from whichever pit may be working, and passes through movable sluices, regulating the respective quantities to be delivered for the Tonge and Jenny Beck sewage, as well as the Croal sewer, passing through the catch-pit into pipes 9 inches in diameter, pouring their contents into the sewage at the mouth of the catch-pit, and the main outfall sewer passing underneath the lime cellar to Hacken. The volume of milk of lime flowing is controlled by a simple valve arrangement, by which means it may be increased or diminished as required.

Hacken Works.

These works are situate partly in the township of Darcy Lever and partly in the township of Great Lever, and are bounded on the north and east sides by Fogg's Lane, on the south by the river Croal, and on the west by a new street, 12 yards wide, leading from Hacken Lane over the new bridge to Smith Road.

Referring to the relative levels of these works, the top water in the settling tanks is 186·08 feet above Ordnance datum, 41·92 feet below the Burnden sewage tanks, 115·17 feet below the Market Hall plinth, and 333·92 feet below the top water of Heaton and Sweetloves reservoirs. The site contains 21¾ acres, and is at the lowest point of the watershed of the borough and the district of the rural sanitary authority, so that the sewage from every building in the Bolton basin may flow to the works by gravitation.

Before proceeding to give the details of the several sections of

the work, it will be as well to describe the course the sewage takes in passing through the works. As previously stated, the precipitating medium, whether milk of lime, animal carbon, or sulphate of alumina, is added to the sewage at the Burnden Works, and is thoroughly mixed and blended together whilst passing down the main outfall sewer, a mile in length. On its arrival at the outlet or junction with the storm sewer it passes through two penstocks to the catch-pit, where gravel and other heavy matter is retained; thence through the screen to the gauge basin, over the gauge, through either of the conduits as desired to one of the detritus tanks, where all solids heavier than flocculent matter are deposited; when this tank is full, the sewage which has left behind the majority of suspended matter flows through the outlets into a conduit alongside, having a bell-mouth connection with a system of iron pipes communicating with settling tanks, each controlled by a valve; these pipes run beneath and through the centre of each tank, and communicate with the surface of the tank floor by means of three large gratings, up and through which the sewage flows until the tank is full; after a period of rest, the effluent is drawn off from the surface by means of six automatic floats through another line of iron pipes into the river, or through the turbine if the detritus or mud tanks require cleansing by the pump. The mud left in the settling tank then flows into one of the mud tanks, whence it is pumped by means of a centrifugal pump to the adjoining land.

Having described the course of the sewage through the works, it now remains to supply details as to materials, size, and construction of the several parts.

The elevation of the junction or bell-mouth where the sewage issues, and of the inlet and outlet of the storm sewer, is formed of tooled stonework, so far as regards the piers, voussoirs, spandrils, string, coping and caps, as also the overflow weir, penstock piers, and seating, and coping forming the same; the walls and inverts are formed of concrete, and cased with blue and red brickwork. The large balanced penstocks, 6 feet by 4 feet, are to turn the sewage on or off the works, and the small one at the west end of the catch-pit is to regulate the volume flowing therein.

Stone Weir.

With a view of preventing damage to the main outfall sewer when the volume is too great to be taken through the works, a

stone weir, 14 feet long, is placed at such a level as to relieve the sewer from pressure or backing-up by discharging the contents into the storm sewer with considerable velocity.

Catch-Pit.

The catch-pit is 132 feet long, 9 feet deep, except at the ends, where it is reduced to 4 feet by an inclined plane, it is 7 feet wide at the top and elliptical in section; the walls are of concrete, lined with brickwork and coped with 6-inch coping 24 inches wide.

Travelling Dredger.

A travelling dredger of simple construction is made to traverse the total length upon rails within the wall lines, supported upon cast-iron brackets built into the solid work and bolted to the concrete, thus enabling the pit to be cleared of solid matter without interfering with the sewage flow.

Screen.

At the east end of the catch-pit a screen, 7 feet square, is fixed, having taper bars, with ½-inch mesh; this effectually arrests the larger sections floating in the sewage, and is cleared by a series of scrapers fitting into each mesh actuated by a chain strap, supported by a framework on each side, and worked with handle and ratchet wheels. It should, however, be stated that the greater portion of the cotton waste and other fibrous matter is retained in the catch-pit by its own gravity. A cross wall, forming one side of the gauge basin, pierced with holes one foot below the surface, tends to arrest the grease and other floating matter from passing over the gauge to the tanks.

Gauge Basin.

In order to secure a correct register of the volume of sewage passing to the works a gauge basin, 15 feet by 10 feet, has been formed, with a cast-iron gauge, 9 feet long. Here, as at Burnden, a white enamel metal gauge-plate, graduated to decimals of a foot, has been fixed on the wall side, to obviate special measurement; the walls are of the same construction as the catch-pit, but the floor is formed of concrete, and left smooth so that it can be easily cleansed.

Safety Overflow.

With a view to avoid flooding of the works a circular cast-iron safety overflow, 5 feet in diameter, has been placed close to the gauge basin, of the form of a tun-dish, having an outlet into the storm sewer, through pipes 24 inches in diameter. This may be regarded as the safety valve of the works, as it is perfectly self-acting.

Conduits.

Conduits of concrete, with red brick lining, and 6-inch blue brick coping, 14 inches wide, are laid to the full length of the detritus tanks; the main conduit is 4 feet wide, and the others 3 feet. Penstocks are provided so that they can work intermittently if desired, the connection between the detritus tanks and the 3-feet conduits feeding the same, is formed by twenty-three openings in the brickwork, 3 feet deep, 4½ inches wide, and 4 feet apart throughout their entire length, thus securing an equal distribution of the sewage throughout.

Tank Walls.

The whole of the walls and floors of the several tanks are made of concrete; the walls where exposed are cased with red bricks tied into the concrete with headers; and the whole are coped with blue Staffordshire coping, 6 inches thick. A band of blue bricks one course below the coping gives a little relief to the elevation.

Detritus Tanks.

The detritus tanks are in duplicate, 96 feet by 48 feet, are 5½ feet deep at the sides, and 8½ feet deep in the centre to the channel line; the floors are finished with fine smooth concrete, which facilitates the cleansing. Each tank has forty-nine cast-iron trapped outlets fixed level with the top water line, discharging into a conduit alongside, 2 feet wide, having a bell-mouth connection with 24-inch iron pipes running beneath the floors and along the centre of each settling tank, which is the only means of communication between these tanks. Provision is made for removing the mud by iron pipes, 9 inches in diameter, laid from the dished channel at the bottom of each tank to the pump in the turbine house. An automatic float draws off the surface water by gravitation preparatory to pumping the mud.

Settling Tanks.

The settling tanks, three in number, measure 297 feet long, 96 feet wide, and 6 feet deep, are alike in all respects; the floors are formed and floated with smooth concrete, dished in three sections from the cast-iron central inlets, with channels to the effluent floats; they are filled from the conduit south of the detritus tanks through 24-inch iron pipes to the first inlet before mentioned, thence through 18-inch pipes to the second and third inlet; when one tank is filled the valve is closed, and a second tank filled; the third one may in the meantime be undergoing a process of cleansing. After the full tank has been at rest for a time and final purification completed, the effluent water is drawn off through six automatic floats into iron pipes increasing in diameter from 9 inches to 24 inches, passing through the turbine house to the river.

These floats are constructed of galvanised sheet iron, the tube is 2 feet 6 inches by 6 inches at the mouth, and is reduced to a 9-inch pipe at the base, buoyancy being maintained by movable air-tight compartments on each side, thus keeping the mouth submerged a few inches, so that the clean effluent flows to the turbine, the float maintaining its level on the surface of the tank as the water rises or falls. Each float is attached to its branch by means of a V joint with brass facings, supported in the centre and at the ends by a wrought-iron shaft 2 inches in diameter, bearing upon a cast-iron frame embedded in and surrounded by concrete.

After the effluent is run off to within a few inches of the bottom, one of the mud-tank valves is opened, and the sludge flows through the inlets whence it came into 18-inch pipes to the mud tank, these pipes serving the double purpose of supply from the detritus tanks and conveyers of sludge to the mud tanks. The cubical contents of the tank space is equal to about one day's supply of sewage.

Mud Tanks.

The mud tanks are in duplicate, 96 feet long and 47 feet wide, having the same depth, section, channel line, mud-pipe connection, and automatic surface float as the detritus tanks, the only means of connection with the settling tank being by means of an 18-inch pipe before mentioned, the valve arrangements being such that any of the three settling tanks can discharge its mud into either of these tanks as found most convenient.

Turbine and Pump.

The turbine house is a brick structure, 21 feet by 15 feet, with concrete foundations below the ground line, and contains the turbine, effluent outlet pipes, centrifugal pump, with the line of mud pipes from both the detritus and mud tanks.

As sewage mud or sludge contains about 95 per cent. of moisture, it is most difficult to remove except by pumping, and it was found that the most economical way of dealing with it was to utilise the head obtainable from the effluent flowing from the settling tanks, by this means 7500 cubic feet of mud can be lifted to a height of 25 feet if desired, with a consumption of 50,000 cubic feet of effluent per hour; the turbine exerts 12 horse-power, the driving pulley is 4 feet diameter, attaining a speed of 160 revolutions per minute, driving a small pulley 12 inches diameter and centrifugal pump, having 8-inch suction and delivery openings; when the turbine is not required to work, the supply throttle valve is closed and the waste valve opened, entailing no expense except opening and closing the valve and keeping the machinery in working order. The turbine is named "Barrett," after the Chairman of the Scavenging and Sewage Committee.

Fountain.

The fountain is supplied from the effluent pipes, and is intended to show the condition of the effluent as it flows from the settling tanks to the river.

River Wall.

The river wall is constructed of concrete, 604 feet long, stands 6 feet above the river bed, and forms a protection to the banks, which, with the earth mounds, will preserve the works from flooding when the river is high.

Gate House.

This building is constructed of brick with stone dressings, and provides committee room, store cellar, and offices, in addition to a residence for the foreman of the works; it was designed by the borough surveyor, Mr. Brockbank, and carried out under his supervision.

Extension.

It will be observed from the plan that there is space for a third detritus and mud tank, though this is not likely to be required for a long time to come, whatever the growth of the district might be; the extension most required will be in the conduits and settling tanks, where the space is practically unlimited.

The difficulty attending the separation of the Burnden from the Hacken Works has been reduced to a minimum by laying an insulated wire through the main outfall sewer, thus establishing telephonic communication between those places.

Cost of the Hacken Sewage Works.

The total cost of the Works may be taken as follows:—

	£	s.	d.
Land	12,294	2	6
Tanks, turbine house, gates, railing, fence, roads, and sundries	10,556	8	4
Iron pipes, penstocks, floats, screen, dredger, valves, castings, turbine, and pump	2,000	0	0
Bridge and approaches, gate house, laying-out the grounds, furnishing, and incidentals ..	3,500	0	0
Estimated further expenditure, including unpaid accounts and balances	2,500	0	0
TOTAL	£30,850	10	10
Estimate for works and land submitted by the Engineer to the Scavenging Committee, March 4th, 1883	34,881	17	6
The Borough Treasurer returns the amount actually paid to 14th October, 1886, as	28,350	10	10

The author designed these works when borough surveyor, and on resigning that office he was appointed engineer, to complete them, having the able assistance of Mr. Edward Stanley Baylis upon the ground the greater portion of the time, as also Inspectors Beckett and Hindley, the latter only for a limited period. Mr. Wm. Longworth, superintendent of the Parks Department, has laid out and superintended the planting of the ornamental portion of the work. Mr. John Fish, of Preston, was contractor for the tanks and conduits; Mr. Robinson, of Bolton, built the Gate House and superstructure of the Turbine House; Messrs. Stanton and Co. supplied the iron pipes; Messrs. J. & E. Wood the penstocks, gauge, &c.; the Streets Department

paved the roads; Messrs. Stott and Co., of Haslingden, supplied the dredger and screen; Mr. W. Gunther, of Oldham, supplied the turbine and centrifugal pump. The cement was obtained by the Corporation from Mr. Otto Trechmann, of West Hartlepool, and the Clithero Cement Co. Mr. Chadwick, of the School Hill Ironworks, supplied the gates and a portion of railing.

Under the guidance of Mr. Jonas Proctor the party proceeded to inspect the Wellington Depôt and the mode of treatment of the town's refuse — the eight-celled Fryer's destructor, and the conversion of clinker into mortar. The Members next proceeded to the Sanitary Depôt at School Hill, where they were met by Dr. Sergeant, Medical Officer of Health, who explained the disinfecting operations by means of Lyon's patent disinfector, in which the bacillaria, the animalculæ of disease, are subjected to 250 *degrees of heat; the supply of steam from the boiler to the washhouse in which the infected clothing is cleansed; the mortuary, dry earth closets, &c. A return was then made to the Town Hall, which was inspected with much interest. After luncheon, which was generously provided by the Mayor, Alderman Fletcher, the Members were conveyed in brakes to the Public Abattoirs, and then to the Sewage Works at Burnden, where the lime-mixing plant is arranged, and afterwards proceeded to the new Sewage Precipitation Works at Hacken. Visits were afterwards paid to the Infectious Diseases Hospital at Rumworth. The Members afterwards dined together at the Swan Hotel.*

ANNUAL MEETING AT LEICESTER.

July 14th, 15th, and 16th, 1887.

ADDRESS OF THE PRESIDENT,

J. Gordon, M. Inst. C.E., Leicester.

Gentlemen,—My first duty on taking this chair is to thank the members of the Association whom I now see before me, as well as those absent who have contributed by their votes to place me in the proud position which I am to occupy as your President during the present meeting, and for the ensuing year. It is a position which is becoming more and more important as the Association, by its own exertions and usefulness, gains as it does in influence, not only with its own members, but with the sanitary authorities of the kingdom. I am perfectly conscious that it is no light task I am undertaking to follow in the footsteps of the worthy representatives of municipal engineering who have preceded me in this chair, and at a time when the Association is increasing considerably in numbers and in that sphere of usefulness to which I have referred, and which I feel sure, if it continues in its present course, will be yet more fully and generally recognised, for there can be no doubt whatever that our Society is doing good work, and after an existence of fourteen years may be looked upon as firmly established as one of the desirable and necessary institutions of the country.

The original object for which the Association was established has been fully maintained in the present aim and usefulness of its operations. The diffusion of knowledge on the subjects coming within the range of municipal engineering in all its varied phases, differing as they must necessarily do in different parts of the kingdom, amongst the members by the papers read and discussed at the various District Meetings during the year, coupled with the

advantage of an opportunity for an inspection of the works to which the papers refer in the various towns, is a distinct and very material advancement upon the very limited opportunities which the municipal engineer had prior to the establishment of this Association, for gaining a knowledge of what is being done elsewhere than in his own town, in the solution of those problems which municipalities and local boards have to deal with to meet the growing wants of their districts, and for the improvement of the sanitary condition of their respective localities. It is to the distinct advantage of the corporations and local boards that their surveyors and engineers should belong to the Association, and take as active a part in its work as possible, for I think I may venture to say on behalf of every member who is in the habit of attending District Meetings, no matter how experienced he may be, that he has in every instance learnt something of advantage, whether it has been some better way of carrying out some particular class of work or some minor detail, or something has been brought under his notice which it was desirable to avoid in any similar works. Very few of our members are able to attend all the meetings held in different parts of the country during the year, and it must not be forgotten that it is at considerable expense on the part of those members who do so, and that consequently the full advantages of the Association will not be realised until the municipal authorities and local boards become impressed with the benefits which would accrue to the towns represented, by knowing that their surveyor attended all such meetings, so as to keep himself abreast of the times in his knowledge of the actual works of the country of a municipal character. This, I am afraid, will never be practicable unless the local authorities themselves come to the rescue, as we heard at our Oxford Meeting in 1883 several boroughs and local boards had already done, as regards the Annual Meeting at any rate, by paying the expenses of the members attending those meetings.

The good effects and results of the Association by bringing its members into contact with each other at the various meetings are, I am quite sure, being felt in all those towns and districts whose surveyors are members of it.

The annual volume of 'Proceedings' forms at the same time a most excellent record and book of reference for its members on nearly all the subjects with which the town engineer has to deal, and it is very desirable that members should make greater use of

it by contributing more of their experience in the shape of papers, even on what may appear subjects of minor importance, in order that it may become the recognised reference book on town engineering, which I am glad to find is to a large extent already the case, inasmuch as the yearly volume is now in request outside the circle of the Association, and that it is highly valued even in America and the Colonies.

Another step in the right direction was taken by our Society two years ago in the establishment of examinations for the office of local surveyors. The success attending the inauguration of that step has been most satisfactory indeed, and deservedly so, I think, when it is considered that in addition to the many other duties the members of the Council have to perform, they are also chosen as an examining Board, and that a section of them devote two days of their time twice a year to these examinations without any remuneration.

It had long been felt that there was no examining body for certificates of competency for local surveyors which fully met the requirements of the case. The Royal Institute of British Architects have for some years held examinations, and granted certificates of competency for district surveyors practising in London, and the Metropolitan Board make it a condition that all candidates for such offices should hold such a certificate. This is, no doubt, as it should be in principle, but the question arises whether the Institute of British Architects is the most fitting body to hold examinations for provincial surveyors, whose duties are scarcely identical with those of metropolitan surveyors working under different Acts of Parliament.

The Sanitary Institute of Great Britain instituted also, some years ago, examinations for local surveyors and inspectors of nuisances, conducted by a Board of Examiners composed of gentlemen eminent in sanitary science. It has been felt, however, that a certificate emanating from a body of gentlemen filling the most important surveyorships in the kingdom, daily and hourly occupied in the practical work which all surveyors to local authorities have to encounter, would be of great practical value, and recommend itself to local authorities.

There is one other body whose certificate would have all the force and weight of authority, not only in this kingdom, but throughout the British Dominions, if that Institution would undertake the task—I mean the Institution of Civil Engineers—because

that body includes within its ranks not only the greatest living authorities on all engineering subjects, but also the chief city and borough engineers and surveyors to local boards of the United Kingdom.

It might be urged that as many of the duties of the local surveyor are of an architectural character, that element would not receive sufficient attention by a body of engineering examiners. On the other hand, whilst many local surveyors are drawn from the architectural profession and have been entrusted with important architectural works, yet it will be conceded that the great bulk of their duties are of an engineering character, and that therefore the engineering element is paramount. An engineering body of examiners would appear to be therefore a more fitting body to examine and certify as to the competency of candidates for local surveyors, than a Board selected from a purely architectural institution, although perhaps both elements should be present on such a Board.

If the Institution of Civil Engineers were to undertake the task, I think it is fair to presume that with so practical a body of men, they would largely select their examiners from that very class of men who have the most complete knowledge of the subject.

What then so natural as that this Association should undertake the task until a Board of Examiners has been established, either by the Institution of Civil Engineers, or by the joint action of all the institutions affected and interested, in which all could have confidence. That the Association was right is shown by the fact that the number of candidates who have presented themselves at the three examinations which have been held, has been much larger at each examination than has appeared before the examining boards of other institutions to which I have referred, and I think the Association is to be congratulated on the inauguration of this new step, and owe a deep debt of gratitude to those members who took such an active interest in its establishment, and also to those active members of the Board of Examiners who have, at great sacrifice of their time, presided so efficiently over the examinations which have already been held.

A perseverance in this work cannot but be productive of good to the community at large, and I am even sanguine that local authorities may eventually follow in the footsteps of the Metropolitan Board of Works, and admit only candidates possessing the certificate of competency of this Association.

I hope, with the assistance and forbearance of every member of the Association, and of every member of the Council in particular, to be able during my year of office to maintain these high objects and aims of the Association, and to hand over this chair, undiminished in importance and influence, amongst the municipal surveyors and engineers of the kingdom. It will be a source of great satisfaction to me, if during my year of office, which has marked the Jubilee of the reign of Her Most Gracious Majesty the Queen, I can in any way advance the interests of the Association, and help to make it still more useful in the promotion and diffusion of that species of engineering knowledge and practice, which, during Her Majesty's beneficent reign, has developed into what is now known as sanitary science, and which has probably contributed more than any other to the saving of life and improved conditions of health under which we now live, not only in our large centres of population, but also in the smaller towns and even villages of the country, as compared with the period fifty years ago, when Her Majesty ascended the throne. The sanitary engineer was not known as such at that period, and he may be said to have sprung into existence eleven years later, on the passing of the Public Health Act, 1848, from which date sanitary knowledge began to spread and develope itself until, twenty years later, it was recognised as a science and special branch of study.

The great strides made in the peaceful Victorian era in all branches of engineering, as well as in the practical application of those sciences which were only in their infancy at its commencement, as, for instance, in the wonderful development of the railway system, not only in the United Kingdom, but throughout the world, the girdling of the globe with the telegraph, and latterly the extraordinary development of the telephone, which was first brought to the notice of the public by Philip Reiss of Friedrichsdorf, near Frankfort-on-the-Maine, in 1861; the wonderful uses to which electricity, as a power of practical utility, has been put during the half century under review in its application as a means of lighting our streets and public buildings with a light approaching more nearly that of the sun by day than that obtainable by gas, which in its turn was undoubtedly a great achievement of science, to say nothing of the development of mechanical skill in the application of gas and water as motive powers, as exemplified in the gas engine of to-day, and the hydraulic lifts, cranes, and other hydraulic appliances, have been in no way greater or attended with more

happy results than the progress which has been made in sanitary science and legislation during the period referred to.

The average mortality for England and Wales was 22·4 in 1838, and in 1886 19·3, which shows a saving on last year's population of England and Wales of 86,400 lives annually, and a saving in suffering from an estimated number of about 1,728,000 cases of sickness.

To accomplish all this vast sums of money have been expended, probably not always wisely, inasmuch as there have been mistakes made in this direction, as in all new developments of science when applied in practice, and evils have arisen which, if foreseen at all at the outset, were underrated.

The great object of the Public Health Act, 1848, was to enable local authorities by its adoption to properly sewer, drain, and cleanse their towns, and to provide efficient supplies of water, free from contamination and impurities dangerous to health. The raising of money by loans repayable in a series of years, which the Act empowered, enabled all these objects to be accomplished, and whilst the first duty of local authorities was undoubtedly the provision of a good supply of water and proper sewerage for the removal of liquid filth from the immediate vicinity of inhabited dwellings, the carrying out of proper works for the latter object has been of much slower growth than the former. Private companies led the way, in fact, in providing supplies of water, inasmuch as there was a prospect of the works becoming remunerative to shareholders investing their money in them, and in nearly every instance where local authorities have eventually found it to be in the interests of the inhabitants of their districts to purchase the works, they have had to pay high prices for the undertaking. This has generally led to a great deal of dissatisfaction with companies holding such works, but it must not be forgotten that the companies would, in most instances, never have had any existence if the local authorities had taken the initiative, and that but for the companies this great boon of a pure supply of water would most probably have been long delayed to many large as well as small communities.

The evils which have arisen from the sewering and draining of towns, have been of a twofold character. Firstly, in the increased pollution of rivers and streams into which the sewage, in the earlier stages of these works, was poured without any previous treatment; and secondly, in the production of sewer gas,

which up to the present moment seems so difficult to deal with. These concomitant evils and difficulties attending the execution of sanitary works are in no way to be underrated, but it still remains the first duty of town authorities to remove, as quickly as possible, all liquid and other refuse from the midst and immediate vicinity of large populations, before putrefaction has had time to take place. There are some minds whose course of reasoning seems to lead them to the conclusion that the evils attending the introduction of modern systems of sewerage are greater than those of the old methods of dealing with town sewage and refuse, but the facts are against them to such an extent, that it would be difficult to point to a responsible medical officer in the kingdom who would be courageous enough to advocate a return to the old régime of cesspools, privy ashpits, open ditches, and flat-bottomed culverts. The introduction of earth closets as one of the safeguards against sewer gas has made no headway for large populations, and is beset with practical difficulties. In the Midland and Lancashire towns the system known as the pail or tub system has been much more largely introduced as a substitute for the water-closet, and it has, from a landlord's point of view, many attractions. In the first place, the first cost, as compared with that of a water-closet, is very small, and the landlord is relieved for ever afterwards, I believe, in most towns, of all future costs and maintenance; whereas in the case of water-closets there is undoubtedly great difficulty in cottage property, in keeping them in good working order, especially during the frosts of winter. There are, however, many objections to the pail system, which it is not proposed to touch upon in this address beyond this, that it appears to be a costly appendage to the water carriage system, without the expected corresponding advantage of relieving the municipal authorities of any of the difficulties of river pollution, inasmuch as the remaining liquid refuse of the town has still to be dealt with by the modern systems of precipitation or irrigation, at practically the same cost as would have been the case, if the water carriage system had been adopted in its entirety.

The Rivers Pollution Act gave an impetus to works for the treatment of sewage, although much had been done prior to that, and Leicester was one of those towns which led the way so early as 1854, in precipitating the solids of the sewage before allowing it to enter the river. The innumerable methods which have since

then been tried, and after large expenditures of money have proved to be failures, show the difficulties of the question. On the whole, however, sewage farms, or a combination of the chemical system with irrigation or intermittent filtration, have been the most successful, so that the first evil to which the cleansing of towns by the increased pollution of rivers gave rise, may now be said to be capable of satisfactory solution, notwithstanding that the old battle of the systems of precipitation *versus* application of sewage to land still wages whenever opportunity occurs.

The second evil to which I have made reference, viz. that of sewer ventilation, seems still unsolved, and I would earnestly entreat members, all of whom have more or less opportunities of experimenting and making observations of the behaviour of sewer gas under certain conditions, to direct their attention to this subject. It is admitted on all hands that the sewers must be ventilated—that is, that there must be a means of escape for the polluted air of the sewers, for it is well known that the conditions prevailing within the sewers during the twenty-four hours of the day are very varying, and on this subject the early observations of the late Medical Officer for the City of London (Dr. Letheby), and the present Engineer for the City of London (Lieut.-Colonel Heywood), and the still more recent investigations of Professor Pettenkofer of Munich, Professor Soyka of Prague, and our own members, Mr. McKie of Carlisle, Mr. Read of Gloucester, and others, are worthy of attention. It does not, however, seem to be so readily or universally conceded that a plentiful supply of fresh air is of equal importance, and that the great aim and object of sewer ventilation should be the introduction of atmospheric air for the purpose of diluting and oxidising the air of the sewers, and the creation of a current to some exit, which shall, if possible, either be above the roofs of the houses, or still better, to some point where the sewer gas can be cremated. The most recent contribution to this subject in direct opposition to these views is to be found in the address of Professor Attfield to the Hertfordshire Natural History Society and Field Club, in which it is laid down that all that is necessary is a vent at an elevation above the ground, and that, therefore, the surface ventilators or other openings for the introduction of fresh air are not only not necessary, but are on the contrary injurious, even when acting as down-cast shafts.

These aims and objects are beset with difficulties, and the most scientific minds of the country have failed so far to devise a

method of ventilation, which shall at the same time be within the range of practical application as regards cost, and universally satisfactory.

The report of last year of a Committee of the Metropolitan Board of Works is worth attention, as showing the opinion of metropolitan surveyors. Out of 40 districts, the opinions of whose surveyors were taken, 35 were in favour of open ventilation, two were doubtful, two against, and one had no experience in this matter. The average distances of the ventilators were from 30 to 200 yards, and the committee came to the conclusion "that pipe ventilators of large section can be used with great advantage in addition to, and not in substitution for, surface ventilators."

To supplement the street openings as much as possible with vertical cast-iron or other shafts up the house sides would seem to be the first thing to do, for there can be no doubt that the more this is done the more perfect will be the ventilation of the sewers. It must also not be forgotten that the anxiety of late years of English sanitarians to protect each house from the possible dangers of sewer gas from the street sewer has led to a system of so-called disconnection of the house drains by a water seal or siphon trap, and that consequently the soil pipes of the houses, which, when carried through the roofs acted as ventilators to the public sewers, have been lost for this purpose, and thus the difficulty of sewer ventilation has been greatly increased.

In Leicester we have been fortunate enough to secure the co-operation of factory owners, who have allowed us to connect no fewer than 52 high chimneys, whilst we have already carried out, at a cost of about 1250*l.*, 146 special shafts up the house sides, with a locked opening upon a large number of them, by means of which we can test the velocity of the current as well as the temperature of the outflowing air. The connections with the high factory chimneys are all of too small a calibre to be of great use, being generally only 6 inches, with a few exceptionally of 9 inches in diameter.

The radius of effect of specially erected chimneys, as shown by the experiments of Sir Joseph Bazalgette, and as experienced with the special ventilating towers erected at Frankfort, is disappointing and discouraging when the cost is taken into consideration. It cannot be expected, however, that manufacturers will admit larger connections to be made with their chimneys, otherwise, of course,

much more satisfactory results would be obtained. To fall back upon special shafts up the house sides means, in my opinion, that there should be probably as many in number as are represented by the soil pipes of the houses, for in this we have a tested example at Frankfort, which, so far as I know, has up to the present moment proved eminently satisfactory. The distance apart of such shafts would largely depend on the size of them, but as a rule it will be found that house owners object to large pipes, in which case the number must be increased, and if we take a distance of about 30 yards, we should require about 5000 such shafts in Leicester.

Whether some artificial means of inducing currents in sewers by drawing down fresh air from shafts above the eaves of the houses, and sending forth the diluted sewer gas to still higher levels, or burning it in an outcast shaft, will take the place of natural ventilation, and prove to be less costly and more certain in its action, remains to be seen; but it is quite certain that notwithstanding the patents which have already been taken out and have failed, and those now before the public, there is still a wide field of research before this question is satisfactorily solved, so that no cause whatever shall remain of complaint on the part of the most fastidious.

One other important question common to all towns is that of the collection and disposal of the ashes and refuse of the households. It is one which is becoming daily more difficult to deal with, especially in those large communities where the old privy and ashpit system has not been entirely abolished. The removal of such ashes is at all times a source of nuisance, and if they cannot be disposed of to the agriculturists of the district they become a source of difficulty. In purely water-closeted towns the so-called dry ashpits cannot be kept in such a condition as to be entirely free from nuisance, especially in the summer months, inasmuch as that the refuse of vegetable and animal matter finds its way into them, and they are in close and inhabited districts necessarily too close to the living apartments of the dwellings; the tendency therefore now is rather to discourage the establishment of ashpits by the substitution of ashbins, to be collected daily or weekly as the case may be, and I think there can be no doubt that from a sanitary point of view, this is by far the best system, harmonising as it does with the general principle applicable to town sanitation of removing all refuse, likely by decomposition to become dangerous to health, as quickly as possible from the precincts of human habi-

tations. The difficulty of disposing of the ashes mixed as they must necessarily be with animal and vegetable matter, is one that is forcing itself upon the attention of all town authorities, and the days of the rich dust contractors of the Metropolis are practically numbered.

Destruction by fire seems to be the ultimate end to be aimed at, and in this respect several towns have led the way; but as this is a subject which will be fully dealt with by a paper to be read during the meeting, I will not anticipate the information which will be brought before you, further than to say that the great end to be aimed at in this method of disposing of the ashes and refuse of towns is greater economy in cost of construction of destructors, as well as in the cost of working them.

The progress in sanitation on the Continent, America, and the Colonies has not been coincident with the progress in England, but these countries have largely benefited by the experience of the United Kingdom, and in some respects their specialists take more extreme views than those of this country in matters of detail. This is, perhaps, more particularly the case with the Americans, who have devised all sorts of exceptional details in connection with private drainage, in order to protect the interior of the houses from sewer gas, and to perfect its ventilation.

In plumbing matters they seem also to be very advanced, and to have established examinations for plumbers, and far reaching regulations for house drainage. Time will not permit me to examine into the works of a sanitary character which have been undertaken in the several countries after the example of England, but they have been attended with similar beneficial results and saving in life and sickness as in this country, although the continental towns which have led the way with such works cannot as yet point to the low rates of mortality for large towns which have been attained in England, with the exception of the German towns of Carlsruhe, Frankfort, Wiesbaden, and Stuttgart, which show death rates of 20·55, 20·64, 22·00, and 21·40 respectively. The greatest reduction of the mortality by the execution of proper sewerage and water works took place in Danzig on the Baltic, and Linz on the Danube, where after the execution of the works, the mortality was reduced by 7·85 and 10·17 per thousand respectively, and in the case of Danzig this reduction is almost exclusively in zymotic diseases.

Berlin is also a remarkable example of the enterprise of German

sanitarians, for there they are demonstrating to the world the practicability of dealing with the sewage from a population of over 1¼ millions upon 16,000 acres of land, of which about 10,000 acres are already under irrigation.

In taking this chair it has been usual when meetings have been held out of London for your President to give some account of the works of his own town. In the present instance I feel that I can dispense with this course, in so far as that I need not do more than generally indicate what has been the course of events since I read to a largely attended District Meeting in May 1884 a paper on the Public Works of Leicester.

At that time large flood prevention works were in course of construction, under an Act obtained in 1881, for continuing the river improvement works executed under previous Acts. The works then under contract extended from the North Mill lock and the North bridge on the north, to the West bridge and Braunstone Gate bridge on the south, along the river and canal, and included bridges, weirs, retaining walls, and some heavy underpinning works in connection with the widening and deepening of the river and canal. These works were duly completed, as well as a further length of works on the river Soar up to what is known as the old grass weir, including the Braunstone Gate bridge added to one of the then running contracts, at a total cost, excluding land and compensation, of 77,000*l*. At this point a halt was made in consequence of the incompleteness of the negotiations with the landowners on the upper reach of the river, and this together with various other circumstances has contributed to great delay in again resuming the works. In the interval a question of whether there should be only one channel for both river and canal instead of two as authorised by the Act, has necessarily added considerably to the delay; but as that has now been settled in favour of the original parliamentary scheme, the authority of the Council has been given to proceed with the whole of the works. One contract, now in progress, which members will have an opportunity of inspecting, was let to Mr. Evans, of Birmingham, in March last, for about 18,000*l*. It consists of a stone and concrete weir, 500 feet in length, with a lock of 7 feet 6 inches lift and large flood basins, retaining and towing-path walls, including a sunk weir parallel with the Midland Railway viaduct. This contract is to be completed by March next. The remainder of the works about to be entered upon, include a new canal and flood channel

about 1447 yards long, and the deepening and widening of the river Soar for a length of about 920 yards, with two or three bridges.

Since the District Meeting referred to, a large and important question has been forced upon the attention of the Town Council, in consequence of the complaints of the pollution of the river Soar, by the effluent from the sewage precipitation works of the borough. An inquiry on the subject was held before Major Tulloch, one of the Local Government Board's inspectors, in September 1884, and it became necessary, in consequence of the Local Government Board's decision in the case, for the Highway and Sewerage Committee to take action in the matter. I reported on various schemes for dealing with the sewage, both by precipitation, some miles lower down the river, in connection with a further purification of the effluent by filtration, and also by irrigation alone. Ultimately, the site known as Beaumont Leys, was chosen, and 1375 acres of land secured for irrigation purposes, 1275 acres by lease for thirty years, at 2*l.* 5*s.* per acre, and 100 acres by purchase. In connection herewith, I advised that a system of new main trunk sewers should be laid down, and the scheme adopted before the site of the new pumping works was definitely fixed, and this course was also adopted by the Council. The sanction of the Local Government Board has already been obtained for 70,000*l.* of the expenditure on main trunk sewers within the borough, and for 13,000*l.* for the purchase of the 100 acres of land. The inquiry was held in April last for the works outside the borough, involving an expenditure of 142,600*l.*, and the sanction for proceeding with this work is shortly expected. The first contract for a section of the main trunk sewers was let to Mr. James Dickson, of St. Albans, in March last, for 12,187*l.*, and is now in progress.

The sewage will be lifted to Beaumont Leys farm by four engines of an aggregate power of 700-horse, a height of 173 feet, including friction; and it is to be expected that with so large an outlay, approaching a quarter of a million of money, the river Soar will not only be restored to its original purity so far as pollution from Leicester is concerned, but that the sanitary condition of the borough will be still further improved, as it has already been, by the enterprise of the Corporation of Leicester in undertaking such large and expensive works, having for their object the improvement of the health of the inhabitants and salubrity of the borough, and I can only trust that the works

to which I have referred may be as successful as the works for the prevention of flooding of the streets and dwellings and factories of the low-level districts of the town so far appear to be, and will, I have no doubt, prove to be in the future.

There are many other works of the borough to which I might have referred, but I feel that I must not only pass them over on this occasion, but apologise for again trespassing beyond the usual limits upon your time; and in conclusion would only add that I trust that whatever differences of opinion there may be on the subjects which will be brought before you during the present meeting, your discussions will be tempered with that forbearance towards each other's convictions which I hope will ever characterise this Association, for it must not be forgotten that every word uttered on the questions before you goes forth to the world in your official published Proceedings as the deliberate opinion of the respective members of an important and authoritative assembly on Municipal Engineering.

Sir Robert Rawlinson: I do not know whether I am putting myself out of order by rising now, but of one thing I am satisfied, that there is no man in this room who is so fit to appreciate your President as I am. I have known him since his nineteenth year of age, and I have been proud to continue his acquaintance until this moment. I know intimately the work he has been engaged in, and the improvements he has introduced into everything connected with sanitary engineering that he has touched; and I earnestly hope and pray that his life may long be spared to you gentlemen and to his country, for I know no sounder engineer than my friend Joseph Gordon. From my heart I thank him for his able address, and hope that his health may be preserved to him to serve his country in the future as he has done in the past. I trust that some day, not very long distant, his country will have learned to appreciate him, and will give him some token of that appreciation. I will conclude by moving that a hearty vote of thanks be given to the President for his able address.

Mr. C. Jones: I have much pleasure in seconding Sir Robert's proposal, and in putting it to the meeting.

The vote was unanimously accorded.

The PRESIDENT: Sir Robert Rawlinson and Gentlemen: As time is of great importance to us to-day, I certainly shall not detain you long in expressing my sincere thanks for the handsome manner in which my old friend, Sir Robert Rawlinson, has thought fit to propose the vote of thanks, to which you have so heartily responded. I much appreciate Sir Robert's kindly feeling in doing so, and I also thank Mr. Jones for having seconded the motion. Sir Robert Rawlinson has referred to the long period that he has known me; and I am sure there is no one who knows anything of sanitary science who will not heartily welcome here to-day so distinguished a sanitarian as Sir Robert Rawlinson. I am sure that all of us who are fairly well read, or are of any age and experience in the profession, know well what Sir Robert Rawlinson has done for sanitary science, and will recognise that we all, as sanitary engineers, are his pupils. I must say I feel proud of his presence here this morning.

ON ASPHALTE AND CONCRETE FOOT-PAVEMENTS.

By GEO. R. STRACHAN, A.M. Inst. C.E., of Chelsea.

The object of this paper is to draw the criticism of the members of the Association upon the experiments and experience of the writer and others, on asphalte and concrete as materials for foot-pavements, and, if possible, to induce others to carry forward experiments with a view to perfecting the use of these pavements.

The writer desires to place in the forefront of the paper the fact that the credit of the Hornsey experiments herein referred to is due to Mr. T. de Courcey Meade, A.M.I.C.E., who most readily placed them at the disposal of the writer for this paper; and also his obligations to the French Asphalte Company, the Val de Travers Asphalte Company, the Imperial Stone Company, and others, for the information given. Every pavement described has been personally examined by the writer, and the exact locality of each is stated, so that any one may examine them for his own information.

Asphalte, properly so called, is a natural compound of carbonate of lime and bitumen, and is found principally in volcanic areas. Men of erudition have asserted that it was the "pitch" used to make the Ark water-tight, and that it was the "slime" used as a mortar in the construction of the Tower of Babel and the city of Babylon. If such ancient uses of this substance are facts, its virtues were strangely lost sight of in the intervening centuries, for it was not till 1700 A.D. that its use became common. It was then used for the purpose of extracting "balm" from its beds, which was used for medicinal purposes, and was credited with superior healing powers. The origin of the asphalte beds has given rise to much speculation. A Swiss geologist has made an effort to explain their formation in a striking manner. Starting from the observation that all organic matter exudes bitumen in decomposing, he suggests that the beds are the remains of huge banks of oysters, the shells of which furnished the carbonate of lime, and the oysters themselves the bitumen. As the asphalte beds are in some cases

27 feet thick, and their areas are measured by square miles, it is evident that oysters were plentiful in those days.

The works of the French Asphalte Company are described, as that company has executed all the asphalte works in Chelsea; but the writer wishes to say that the Val de Travers Company, Claridge's Asphalte Company, and others do equally good work.

The mines of the French Asphalte Company, from which their English supply of asphalte is obtained, are situate at St. Ambroix, in the south of France. The asphalte is in seams, which lie nearly horizontal, and which have their faults, bends, &c., like coal seams. The bed and roof of the seams are of pure carbonate of lime rock, presumably the same as that of which the asphalte is largely composed. The seams vary from 3 to 5 feet in thickness, and are worked by drifts from the outcrop on the hillside. The rock is mined by blasting and hand labour, and comes from the drifts in pieces measuring 1 cubic foot and downwards. The asphalte then has a very dark chocolate colour, and appears to be a tough homogeneous substance, with striations of white matter running through it parallel to its natural bed, which are probably narrow seams of carbonate of lime. When it is exposed to a hot sun the surface will glisten with small fatty beads of bitumen, but at ordinary temperatures it is dry. After exposure to the air the surface turns a dull white colour, owing to the evaporation of the bitumen; but this change is only skin deep. The rock is conveyed to Marseilles just as it leaves the mine, and is shipped to England. Formerly the beds of asphalte yielded a supply of natural bitumen, but twenty years ago the supply ceased, owing, it is believed, to some widespread cause, as several mines were affected in the same way at that time.

At the depôt of the company at Stratford the rock as delivered by ship is passed through a crusher which acts like a Blake's crusher, save that the solid jaw is replaced by a series of knives, by which it is reduced to pieces not exceeding 3 inches in length. These pieces are poured into a Carr's disintegrator, which has spindles revolving 800 times a minute in opposite directions, and which reduces the asphalte to powder. The powder is screened through a rotatory cylindrical sieve (144 to the sq. inch) and is then stored in sacks. The asphalte varies in the proportion of bitumen it contains. The richer parts are ground and stored separately from the others, and are afterwards mixed in suitable proportions for the particular use to which they are to be applied.

The following are analyses of asphalte rock of average richness at this stage :—

	No. 1 Sample.	No. 2 Sample.	Average.
Bitumen	10·70	10·60	10·65
Carbonate of lime	88·05	88·15	88·10
Silica	0·55	0·40	0·48
Alumina	0·10	0·15	0·12
Peroxide of iron	0·20	0·10	0·15
Moisture	0·40	0·60	0·50
	100·00	100·00	100·00

When the asphalte is about to be used, the powder is poured into revolving roasters, and roasted for three hours at a temperature of 280° F., during which operation the moisture is driven off. As the asphalte chars at 320° F. care has to be exercised as to the proper temperature. It is loaded direct from the roasters into carts lined with sheet iron, covered with hemp cloths, and thus protected it retains its heat till it is taken to the site where it has to be laid. It is carried from the carts in barrows, spread over the foundation by means of a rake and rammed solid by a series of blows from heavy heated rammers. The surface is ironed by a heated iron, which draws bitumen to the top, and in a few hours it is ready for traffic. This form of asphalte is known as compressed asphalte, and is the form always used for carriageways and frequently for footways.

The other form of asphalte is known as mastic asphalte, and is a manufactured compound made up of natural asphalte, artificial bitumen, and grit. The asphalte is reduced to a powder as described. The artificial bitumen is used because of the scanty supply of natural bitumen. Its principal component is Trinidad pitch, to which is added from 5 to 7 per cent. of shale oil. The mixture is boiled for twenty-four hours; the top liquid is ladled out, which is the artificial bitumen. It is a soft, viscous, black substance which softens under the sun's rays. Its quality is tested by taking a piece between the fingers and drawing it out to a string ; if it does not snap until drawn out very fine it is of good quality. The grit is obtained from Bridport, and is wholly composed of flint, very clean, and the pieces do not exceed $\frac{1}{8}$ inch in size. The mastic asphalte is prepared as follows:—From 5 to 7 per cent. of artificial bitumen, from 20 to 30 per cent. of grit, and the balance in powdered asphalte are placed in a covered

cauldron and heated for four or five hours. The mixture liquefies at 280° F. to 300° F. If it is to be used near the works (within 10 miles), it is run into locomobiles (boilers on wheels), with a fire under them, and drawn to the site. When it is used it should be hot enough to vaporise a drop of water. It is carried in pails and spread over the foundation by means of a float. Silver sand is then spread sparingly over the surface and rubbed in by floats. In six hours the footway is ready for traffic. One ton of asphalte covers 20 square yards when laid 1 inch thick.

When mastic asphalte is to be laid at a distance from the works instead of running it from the cauldrons into the locomobiles, it is run into moulds, and moulded into flat cylindrical pieces weighing about 56 lb. each. These are taken to the site, and placed in a cauldron. From 3 to 4 per cent. of additional bitumen is added to make up for the loss by evaporation, and heat applied to reduce them to a liquid condition. The laying is then performed in the same manner as before described.

This description may be taken as applicable to the method adopted by the Val de Travers Company, with a few variations in the proportions used. The following analyses of asphaltes are of interest, as they are those of rocks of average richness:—

	Val de Travers Co.	French Asphalte Co.
Bitumen	9·75	10·65
Carbonate of lime, &c.	89·75	88·85
Moisture	·50	·50
	100·00	100·00

The following analyses, in a different form, were placed at the writer's disposal by Mr. Meade:—

	Val de Travers.		French Asphalte Co.		
	Rock.	From Cheapside.	From Hornsey Lane.	From Crescent Road.	Rock.
Silica	0·6	0·5	0·3	0·4	0·4
Volatile organic matters (tar oils, &c.)	5·8	5·8	6·5	6·0	8·2
Non-volatile organic matters ..	13·0	9·8	13·6	16·9	16·8
Lime, &c.	80·6	83·9	79·6	76·7	74·6
	100·0	100·0	100·0	100·0	100·0

This detailed description and the numerous analyses of good asphaltes have been given, so that spurious asphaltes may be avoided.

In Chelsea there are 16½ miles of footways paved with mastic asphalte, having an area of 68,290 square yards. On the Queen's Park Estate there are 41,500 square yards, which have been laid five years, and which are now in good condition, not having cost one penny for repairs. In King's Road, at Walpole Street, a length has been laid for seven years. The foot traffic over it is 7500 persons in eighteen hours. At the end of the first five years it was cut open, and the wear was found to be such as had reduced the thickness to a spare ⅞ of an inch, the original thickness being 1 inch full. On the east side of New Bond Street a length of mastic asphalte was laid thirteen years ago between Oxford Street and Conduit Street, the thickness being ¾ of an inch. The asphalte is now wearing through on to the concrete in the line of traffic at the forecourt line. The cost for repairs has been so trifling that it may be neglected. In this case the concrete foundation is as sound as before, and all that is necessary to restore the footway is to relay the asphalte at about two-thirds of the original cost, when the pavement will be good for another thirteen years. As the traffic here is very severe and the footway narrow, it is reliable evidence of the durability of asphalte.

The foundation for the asphalte footway is made with 3 inches of Portland cement concrete (6 to 1) of a very good quality. The surface is smoothed with the shovel, and four days are allowed for drying. The concrete has been laid hitherto without any joints. The mastic asphalte is floated over this surface, and the path is then completed. Mastic asphalte does not show any cracks on the surface. The concrete foundation, when the asphalte is removed, shows the irregular, tree-like cracks all along its length, branching from the kerb to the back line, but the elasticity of the mastic asphalte is sufficient to resist the tearing action of the concrete as it contracts.

A study of the asphalte question resolves itself principally into a study of the movements of concrete when laid in long lengths, narrow widths, and small thicknesses. The writer inclines to the opinion that concrete has in itself a small power of contraction, apart from any considerations of temperature. The experiments of Dyckerhoff which show that neat cement (slow setting) had an average expansive power over twelve months of ·0734 per cent.,

and quick-setting cements of ·2019 per cent., and that concrete (3 to 1, sand) had an expansive power of ·0264 per cent. (slow setting) and ·0320 per cent. (quick setting), seem to show the contrary to be the case. The writer laid down a length of concrete (6 to 1, ballast) 52 feet long, 12 inches wide and 3 inches thick, under a shed which had an open front, but so that the sun did not touch the concrete. The strip was laid on sand so as to give it freedom of movement. Another strip 26 feet long, of the same width and thickness (3 to 1, pebbles), and a third of the same dimensions (3 to 1, sand) were also laid under the same conditions. The only movement discernible, at the end of one month, was a slight contraction in length in all the samples. The uniform experience of concretes under asphalte is that cracks occur, which would tend to show that contraction and not expansion is the rule. At the same time, the writer has experience that concretes do expand, but this he attributes to the action of temperature. It is no uncommon thing to see the surface of an asphalte path raised crosswise in an irregular line, as though a small tree root was under it. In every case where the asphalte has been uncovered at these points by the writer, he has found the concrete crushed and the concrete on the falling level thrusting itself under the concrete on the rising level. This effect is most marked on hot days. In January last the writer laid some thousands of feet of asphalte path in St. Luke's Gardens, Chelsea. The sun is on it all day, and during the hot weather at the beginning of June, the number and size of these raised lines was astonishing. Shortly after midday they were most pronounced, and towards night they were less prominent. As a further evidence of the expansion of concrete under the sun's rays the streets in the City can be named. The footway and carriageway are in asphalte on concrete. The expansion of the concrete in the carriageway presses the kerb at the bottom; the expansion of the concrete in the footway presses the kerb at the top on the opposite side, and the two have tilted up the kerb in a marked manner. The writer has on a hot day taken up asphalte on a footway and has found the heat much greater under the asphalte than on the surface. In order to avoid the expansion showing itself in footways the concrete should be laid in sections, and the joints between them filled with some compressible substance.

Compressed asphalte has about one-third longer life than mastic asphalte under the same conditions. The cost is the same, but

the use of compressed asphalte for this purpose has not been universally followed by reason of the cracks that appear on its surface. The cracks do not tend to spread under traffic, nor does the asphalte wear more at these parts than at others. They are unsightly however. It is found that these cracks are exactly of the shape and in the position of the cracks in the concrete foundation. Compressed asphalte has no elasticity in itself, and when subjected to the contracting force of the concrete it is torn through. It is an admirable tell-tale of the movements of the concrete. Much ingenuity has been displayed in endeavours to avoid the cracks. The first step was to localise them. This was done by laying the concrete in 12-feet bays and in alternate bays, and filling up the screed space with fine concrete. The contraction then showed its effects at these places, with a result that a series of regular straight cracks appeared instead of the irregular tree-like cracks when the concrete was laid in one piece. These effects can be seen at many places in London without specifying any particular place. Having localised the cracks, an experiment was made at Hornsey to avoid them. A strip of bituminous felt 6 inches in width and $\frac{3}{16}$ inch thick was placed on the concrete over the whole length of the screed mark. This felt has much elasticity, and the object of the experiment was to ascertain whether it would take up the contracting movement of the concrete and absorb it. The length is laid at Crouch Hall Road, between Coolhurst Road and Clifton Road. The result has been that instead of one crack at each screed mark there are two, one on each side of the narrow strip of felt. It is evident that the concrete in contracting compresses the asphalte longitudinally, and that the cracks appear at the points where the opposing motions meet; and as the strip of felt represented a narrow area which was free from these forces, a crack appeared on each side where the forces took effect. In Archway Road, Hornsey, another experiment was made by covering the screed mark with a strip of mastic asphalte 9 inches in width and $\frac{1}{8}$ inch thick, just as in the last case with felt. For three months no cracks appeared; then a few slowly and at irregular intervals showed themselves; but during the severe winter of 1886–7 every screed mark showed its crack. These cracks are irregular in line, but they are confined in each case to the area covered by the mastic asphalte. These footways are laid on a 3-inch foundation of concrete. In Marlborough Road, Chelsea, an experiment was made on different lines. A

foundation of concrete 6 inches thick was laid, and the compressed asphalte laid on it. For four months no cracks appeared, but after that time they occurred at frequent intervals, though they are fewer than usually appear on a 3-inch foundation. When the asphalte and concrete were removed at the cracks it was found that the crack extended through the whole thickness of the concrete. This experiment was based on the observation that cracks do not appear in compressed asphalte carriageways, and as the principal difference between the foundations in the footways and carriageways is the thickness of the concrete, it was assumed that it was the cause. The observation is, however, an incomplete one. In streets of light traffic the cracks do appear in the asphalte, as in Little Blenheim Street, Chelsea, and elsewhere. In streets of heavy traffic the cracks in the concrete tear the asphalte as they slowly form, but the traffic welds the asphalte together again before they show on the surface. In footways of heavy traffic there are fewer cracks than in those of light traffic, for a similar reason. At Muswell Hill, Hornsey, the experiment of covering the whole of the area of the footway between Onslow Rise and Grosvenor Gardens with bituminous felt was tried. The felt was in 3-feet widths, and was laid longitudinally with butt joints. At the circular kerb the pieces were necessarily somewhat patched. The result has been that cracks have appeared at every joint of the felt with marvellous fidelity, owing to the movement of the concrete. In Whitehead's Grove, Chelsea, between Marlborough Road and Keppel Street on the north side, a length was laid in 1885 on a 3-inch concrete foundation, which was covered with mastic asphalte $\frac{1}{4}$ inch in thickness. On this $\frac{3}{4}$ inch of compressed asphalte was laid. The mastic asphalte was laid to absorb by its elasticity the movement of the concrete without transmitting it to the compressed asphalte. It has survived two winters of great severity, and has lived twenty-one months without any cracks appearing. From this it would appear that the principle of a material between the concrete and the compressed asphalte which will absorb the effects of the movements of the concrete is a correct one, and the writer invites the members of the Association to experiment on cheapening the method. The present result is an increase of life of 33 per cent. at an increase of cost of 12 per cent.

As evidence of the durability of compressed asphalte in footways, those in Cheapside may be named. They were laid in 1876 at a

thickness of 1 inch, and are now wearing through. On the south side of the Strand east of Wellington Street 1 inch of compressed asphalte was laid in 1881, and has had only the most trifling repairs. The streets in the City with the heaviest foot traffics in the world are paved with compressed asphalte on the footways.

The advantages of asphalte foot-pavements are durability, a smooth surface unbroken with joints, a good foothold, even and regular wear, their impervious character, and the readiness and neatness with which they are repaired. They have a sombre appearance, and show water on their surface longer than stone pavements. They wear to the last thickness without breaking up, and give a useful wear for the whole of their thickness. When a stone or other pavement has worn 1 inch it may not be half worn through, but its useful life is over. Where there are cellars under footways, asphalte as a material for footways is unrivalled. In ordinary traffics, such as those named in King's Road (7000 to 8000 persons per day), an asphalte pavement can be laid 1 inch thick with the certainty that for at least ten years it will need no repairs whatever. This pavement has also the advantage that the foundation is always preserved and good for use again when the wearing surface of asphalte has to be renewed.

The following abstract of the present contract schedule in Chelsea will give the prices for these pavements:—

	Per sq. yd. £	s.	d.
Compressed or mastic asphalte 1 inch in thickness on 3 inches of concrete	0	6	3
Ditto, ditto, ¾ inch thick	0	5	6
Compressed asphalte ¾ inch thick on ¼ inch of mastic asphalte, laid on 3 inches of concrete	0	7	0
Compressed or mastic asphalte 1 inch thick on existing concrete foundation (relay)	0	3	6
Ditto, ditto, ¾ inch thick	0	3	0

These prices carry a guarantee of free maintenance for ten years. The Vestry prepares the foundation for the concrete in new work at a cost of 2*d.* per square yard. The specification provides that the asphalte will be cut open at distances not exceeding 50 feet apart, and the thickness measured. Five out of every six of these measurements must be at least the specified thickness, and the average of every six must be at least the specified thickness. The specification is strictly adhered to. The

cost of the foot-pavement in New Bond Street already referred to, over twenty-six years would be as follows at per square yard:—

	£	s.	d.
Preparing foundation	0	0	2
Laying concrete foundation and ¾ inch mastic asphalte ..	0	5	6
At end of 13 years relaying mastic asphalte (life 13 years)	0	3	0
Repairs	0	0	0
Total	£0	8	8

or a cost per year, not including interest, of 4*d.* per square yard. It should be mentioned that the small cost of renewing asphalte footways is due to the fact that the asphalte taken up is as good as new asphalte after it has been cleaned and prepared, and is re-used for footways.

In dealing with the question of concrete as a material for foot-pavements, the writer cannot claim such an experience of it as he has had with asphalte. In 1880, however, the Vestry of Chelsea had laid by the respective makers a series of pavements in King's Road against the Royal Military Asylum wall, and in 1885 a report was made on them by the writer. So many applications for copies have been made that it is now out of print, and as applications continue to be made, the results of the experiments are herein set forth for the information of the Association.

The writer holds that a knowledge of the manufacture of these pavements is useful information, and therefore he incorporates a description of the manufacture of Imperial Stone Pavements. The depôt of the company is at East Greenwich, on the banks of the Thames. The aggregate used by the company is broken granite. Flint has been used, but the pavement in wear became very slippery. Kentish rag has also been used, but its wear was too rapid. The granite is broken, so that it passes a $\frac{3}{16}$ sieve. After screening it is carefully washed, as the dust acts as a coat round the piece, and prevents the cement laying hold of the granite. The washing machine is a slanting archimedean screw, working in a trough, with openings in the thread of the worm. The water is run in at the high end, and the screened granite pieces put in at the lower. The screw churns the pieces over and over each other, and carries them up by its motion. The clean water meets the cleanest granite, and thus the pieces are not soiled by the dirty water they make. About 8 per cent. by weight is washed out as waste. The importance of a clean aggregate is seen when it is stated that briquettes made from washed pieces have a tensile strain of 15 to 20 per cent.

higher than those made from unwashed pieces, when tested under similar conditions. The cement used is the best Portland, and is required to stand a tensile strain of 350 lb. per square inch after seven days' immersion in water. As a matter of fact, the cement used runs to an average of 425 lb. on the square inch. Hitherto a residue not exceeding 10 per cent. on a 50-mesh was allowed, but the value of increased fineness is recognised, and preparations are being made for a cement that will not leave a residue of 10 per cent. on a 76-mesh. The weight runs from 116 to 120 lb. per striked bushel. Before use, the cement is laid out to cool for fourteen days, and is turned over frequently in that time. Great care is taken to keep the direct rays of the sun off the cement. The company exposed part of a sample of cement to the sun, and exposed the other part to the air. It was found that the part exposed to the sun showed a loss of strength equal to 50 per cent.

The soluble silica used for the induration of the stone is a clear viscous substance made from pure flint and caustic soda, which are digested by heat under pressure in Papin's digester or an analogous machine. Its strength is technically known as 140° Twaddle, which shows 1700 on a hydrometer. The silica is diluted with water until it shows 1250 or 1300 on the hydrometer, and is then a clear copper-coloured liquid.

The stone is made of three parts by measure of washed granite and one part of cement. They are thoroughly incorporated in a dry state in a horizontal cylinder by machinery, and when this is secured, water is sparingly added, and the mixing continued. At each mixing there is made sufficient concrete for a 3′ 0″×2′ 0″×2″ slab only. When it is ready for putting in the mould, the concrete does not appear to the eye to be sufficiently wet. The moulds are metal-lined, true in shape, with clearly defined arrises. Before the concrete is placed into them they are oiled all over, and then placed on a trembler. This is a machine which gives a rapid vertical jolting motion to the mould. When the machine is started, the concrete is placed into the mould by small shovelfuls at a time, and two men with trowels spread it over the mould. When the mould is filled they pat the concrete with the trowels, the water rises to the surface and an even smooth face is secured. The mould and concrete are then removed to a rest for two days. The whole operation of mixing the concrete and making the slab in the mould is completed in six minutes. Machine-made stones are of necessity homogeneous, as veneering is impossible during the

process. The slabs when taken from the moulds at the end of the two days are air dried for seven or nine days, and then immersed in a silica bath for seven or nine days more. They are then stacked in the open for some months before use. The value of the silica bath is in hastening the hardening of the stone. At the end of a month the stone will stand from 30 to 40 per cent. more tensile strain if silicated than if air dried only. It is doubted by Mr. Faija whether silicating increases the ultimate strength of concretes.

The stone so prepared stands a tensile strain of 650 lb. on the square inch when three months old. Strains of 1000 lb. have been obtained, but they are not the average. The value and excellence of this concrete is shown by the fact that though the neat cement has 75 per cent. of aggregate added to it, yet in three months the mixture bears nearly double the tensile strain of the neat cement after seven days. The writer was shown the original of a report by Kirkaldy, dated the 6th September, 1882, in which one sample of stone took 8075 lb. per square inch to crush it, and another reached the marvellous strength of requiring 9492 lb. per square inch.

In the King's Road experimental pavements the makers laid their pavements with the knowledge that they were competing with their rivals. They were laid in 1880. Asphalte, York stone, Ferrumite stone, Victoria stone, and Imperial stone were laid side by side and subjected to the same traffics. The writer includes the York stone results, though not strictly coming within the subject of the paper.

In June 1884 the Ferrumite stone was removed, as its slipperiness had become a source of danger. Its area was taken by Wilkinson's granite concrete pavement and by Shap-stone pavement. After five years' wear of the original stones, the following results were obtained :—

The York stone occupied an area of 87 square yards ; the original thickness was 3 inches; the number of stones 123, of which, after five years' wear, 10 had broken edges, 16 had broken corners, 21 had their surfaces peeling off, and 6 were worn so as to be dangerous. The wear was not measurable by reason of the uneven thickness of the stones, but it was unmistakable. The foothold was good in all weathers. The actual cost was 8*s.* 7*d.* per square yard laid.

The Victoria stone occupied an area of 81½ square yards ; the

original thickness was 2 inches; the number of stones 168, of which 35 had broken edges and corners, 2 had their surfaces peeling off, and 3 were visibly cracked across. The wear was not quite $\frac{1}{8}$ inch at the greatest traffic line. The joints of the stone were pleasing, and the colour cheerful. The foothold is not so sure as that of York stone in dry weather, and in a drizzling rain it approaches slipperiness. The cost was 6*s.* 4*d.* per square yard laid.

The Imperial stone occupied an area of $90\frac{1}{4}$ square yards; the original thickness was a full $2\frac{1}{8}$ inches; the number of stones 187, of which 18 had their corners and edges broken, and one had its surface partly peeled off. The wear was not quite $\frac{1}{8}$ inch at the greatest traffic line. The regularity of the joints is pleasing to the eye, and the colour is light and cheerful. The foothold is more sure than that of the Victoria stone sample, but it becomes somewhat slippery in drizzling rain. The cost was 6*s.* per square yard laid.

The experience gained with the Shap stone laid in 1884 is more limited, but the stone does not appear to be better than the concrete stones described. The length laid *in situ* by Messrs. Wilkinson is subject to the same remark, but the aggregate is already wearing up. It is laid in 8-feet bays. A repair made in it is a great dissight to it. The effect of the traffic in wear is visible.

Mr. Walker, of Leeds, has laid down (1886) in King's Road a short length, in bays about 4 feet square. It has a very smooth surface, and appears to be a very good pavement. He lays a foundation of ballast concrete $2\frac{1}{2}$ inches thick to within $\frac{1}{2}$ inch of the finished surface, and cuts roughly through it so as to form the bays. He then floats the surface with fine rich concrete, made of one part of cement to one or one and a quarter parts of crushed granite or slag which pass through a $\frac{1}{16}$ sieve. This is then cut through with a knife into bays of small areas. The foothold is fairly secure and the wear very satisfactory. No cracks appear when the bays are made less than 10 feet square. At 322 Oxford Street a piece has been down three years, and no wear is visible. He claims that his fine rich concrete on the surface attains more nearly to the texture of York stone than any other pavement. The joints, however, have a tendency to spread.

Concrete pavements laid in slabs have two serious disadvantages. The writer's experience refers to Victoria stone, but there is no reason to suppose that slabs of other make are free from them. The first is the annoyance caused by the hard metallic sound of

the footfall on them, which is especially noticeable at night. The other is their brittle nature and the presence of hidden cracks after wear. When taken up to relay, it is often found that a stone which was apparently sound, breaks before it can be relaid.

Concrete pavements *in situ* have the serious disadvantage that they cannot readily and cheaply be repaired. A patch in them shows for the whole life of the pavement, unless a whole bay is removed.

The writer is of opinion that concrete pavements *in situ* are preferable to concrete pavements laid as slabs. There is, however, no reason why this pavement should not be laid by surveyors themselves, without the aid of a contractor. Much has to be learned before concrete as a material for foot-pavements is perfected, but that can most readily be learned by each engineer doing his own work, and exchanging experiences. The prices paid for concrete pavements are very great. One stone is advertised for 7*d.* per square foot, which equals 4*l.* 14*s.* 6*d.* a cubic yard. This is an extravagant price to pay for concrete, even if it be of the very best kind, and silicated too. Concrete for foot-pavements has its own field, and within well-marked limits its use is advisable, but until its capabilities are more largely tried and its usefulness increased, the full advantage will not be obtained from it. The price stated is large enough to cover the cost of experimenting, and the writer trusts that the Members will carry out such a series of tests and trials as will complete the knowledge of concrete as a material for foot-pavements.

DISCUSSION.

Mr. R. Vawser: I would just draw the attention of members of the Association to the advantage derived, in laying concrete footpaths, from placing a simple strip of wood—red deal or something of that kind—between the various blocks. If any of you happen to go to Macclesfield, you will find a large quantity of concrete paving has been laid there, and the surveyor has adopted this plan of putting a lath between the different blocks. I think he makes his blocks about 4 feet square, puts in a lath, and lays his concrete close to it. It is his experience that the elasticity of the timber is sufficient to prevent the concrete from cracking, and from the observations I have had the opportunity of making upon it, it appears to me a very great success. I suggest that a small piece

of wood between the blocks will be found more appropriate than the felt which Mr. Strachan has tried. With regard to the reasons for the expansion of concrete, I think it is pretty well known amongst us, that concrete does expand in setting, and no doubt likewise expands with heat, whether laid in blocks or otherwise. All metals and all stones expand in the same way. There is a very interesting book published by Mr. T. Mellard Reade—I think it is called 'The Origin of Mountain Ranges,' in which he treats of the expansion of various stones by heat, and this work would be very valuable to any one who proposes to make experiments on the subject. I have very great satisfaction in complimenting Mr. Strachan on the success of his paper, which undoubtedly is an excellent one, and equal pleasure in proposing that the best thanks of this Association be given to him for it, and for having so carefully compiled the statistics.

Mr. A. M. Fowler: I can heartily bear my testimony to the paper being a valuable one. With regard to the contraction and expansion of concrete, I may say that, some seven years ago, I laid down the Newcastle Cattle Market with concrete; and I foresaw this danger of cracking in such a large surface of several acres. I there had an iron lath placed round the boundary of each block, and filled in the joints thus made with another class of concrete, little better than sand. I believe that, to this day, there are no cracks in this surface. A great portion of it, too, was done in frosty weather, but of course we covered it with sand, to keep the frost from it; it is very desirable in making a large surface of concrete to provide for the expansion of the concrete in a similar manner. I have great pleasure in seconding the vote of thanks to Mr. Strachan for his valuable paper.

Mr. E. B. Ellice-Clark: I should like to make a few remarks on the able paper which has been read by Mr. Strachan. A good deal of the early part of the paper has been discussed before in our Proceedings; but with regard to the behaviour of asphalte when laid for footpath traffic, considerable experience has been gained subsequently. My experience is a little different from that of Mr. Strachan. A compressed asphalte footway, three-quarters of an inch thick, was laid down at Hove by one of the asphalte companies, and, under a very moderate traffic, at the end of three years it required very considerable repair. I have frequently noticed, in Buckingham Palace Road particularly, that the footways wear out rapidly. The cause of the wearing out of

compressed asphalte at Hove was owing to it not being sufficiently thick. Where the mastic asphalte is laid—and a good deal is laid in Hove—it is always three-quarters of an inch thick; and mastic asphalte always behaves better than compressed asphalte of this thickness. From my experience of compressed asphalte, I should say it ought never to be less than an inch thick, and I should myself prefer to have it a little thicker. With regard to the observations made respecting asphalte cracking, I think the only objection to the cracks is their unsightliness. I quite agree with the writer of the paper, that, however numerous the cracks may be, they do not detract from the wear of the asphalte. True, hard frosts have some effect on the asphalte at the cracks, but, speaking generally, I should say their unsightliness was really their only practical defect. In streets of great traffic, where people have something else to do than to look at the pavement, I do not think the cracks a great defect. Mr. Strachan speaks of the impervious character of asphalte over cellars. That is a small advantage, but it is a very doubtful one except in streets of great traffic. There is no doubt compressed asphalte is affected much by traffic. I believe, although it seems an anachronism, it is improved by traffic. This is the experience of Col. Heywood in London. There are two kinds of wear—weather wear and traffic wear; and the experience of the City engineer of London is, that in streets of great traffic asphalte wears longer than in streets of lesser traffic. I should have been glad if Mr. Strachan had reduced some of his figures to some kind of unit. Figures are exceedingly valuable, but it is always better—if I may throw out the suggestion—that they should be reduced to a unit. If we had had the average temperature to which the asphalte under consideration had been subjected recorded, and the extremes each way, and we had had the number of passengers who went over it—just as Mr. Deacon did in his paper before the Institution of Civil Engineers—we should have been in a better position to arrive at results. The terms "light" and "heavy" traffic are exceedingly ambiguous. A heavy traffic at Brighton would in a town like Liverpool be considered rather light. It is well worth while attention being given to recording the results from the actual number of passengers that pass over any particular kind of pavement. With regard to the specification for concrete, I should like to ask Mr. Strachan whether he found it possible in practice to get Portland cement weighing 116 to 120 lb. per striked bushel with

the fineness he describes. He says, "Hitherto a residue not exceeding 10 per cent. on a 50-mesh was allowed, and preparations are being made for a cement that will not leave a residue of 10 per cent. on a 76-mesh." I have used a good deal of cement, and paid a good deal of attention to it, but as far as my experience goes, the fineness is in inverse ratio to the weight. If you have exceedingly fine cement, to which I personally attach great importance, you cannot get great weight. Perhaps Mr. Strachan will state, when he replies, whether he is able in practice to get such a cement, and where it is to be got, and what is the price? The observations on concrete footways are exceedingly valuable. An expression of opinion was made in this Association some years ago, that, at a distance from flagstone quarries, concrete pavement would largely supersede flagstone pavement. That is now the case. There is in West Brighton, I believe, the oldest piece of concrete pavement in the world. There formerly lived at Brighton a Mr. Highton, who, I think, was the founder of the Victoria Stone Company. He made his experiments in Hove, and a piece of pavement which was taken up there a few days ago had been down ever since 1854. It is made of ordinary beach, and has only been subjected to a very light traffic. It is of no importance in that respect, but it is of great importance so far as it shows that, in the early days of Portland cement manufacture, and with slight knowledge, an amateur produced a concrete which, at the end of thirty years, has stood the great variations of temperature in this country. The expansion of thin concrete is a very interesting subject. Lately there has been laid, opposite West Brighton Lawns stage, a pavement 1200 yards long, and on the average about 26 feet broad. Two of the artificial stone companies were given the contract, and practically, with some limitations as to cement, they had their own way in the matter. They both adopted the same size for laying the slabs in at one time. The practice mentioned by Mr. Vawser has been discontinued by those who have had any experience of Portland cement in mass. It is not necessary to have any strips of wood. We had a path paved twelve years ago with strips of wood, and the behaviour of the concrete has been just as bad with it as without it. The plan adopted by the two large companies I have mentioned was simply to lay two slabs of concrete on alternate days. The first was laid one day, and the next two or three days afterwards, according to the state of the weather and the work. Up to this summer, when

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it will have been down four years, the pavement presented few irregularities. This summer, however, it has risen in one instance at the joints about 3½ inches, and that, too, in the smallest surface. The largest slabs are about 7 feet by 6 feet by 9 feet, and where the concrete has raised up at the joints the strip is about 24 inches wide and the lengths are about 6 feet. It is difficult to account for the fact that the larger slabs, where one would have expected to have found the largest amount of expansion, have not expanded, but that the smaller slabs have. It shows that what Mr. Strachan says is quite correct, that the behaviour of concrete in long slabs is very peculiar, and that very little is known about it. Speaking from twelve years' observation of concrete pavements, I believe they will supersede for economy all other kinds of pavement where a place is far removed from where quarries enable flagstones to be readily obtained.

Mr. J. W. Cockrill: My excuse for rising is, that I have under my charge, thirty miles of concrete pavement, which, under heavy traffic, has stood well. It is laid as Mr. Fowler has described, with wooden splines in the joints, and it is the only way in which I can get concrete to stand. I use as a base shingle from our beach, which costs about 1*s.* 3*d.* per yard ready for use. I had a contract last year for 20,000 yards. The contract price was 1*s.* 9*d.* per yard, and it is quite equal to what I know has been standing well for sixteen years. I am confident that, in many towns, concrete pavement will be the pavement of the future.

Mr. A. W. Parry: I do not think that the price or the wearing power has much to do with the value of concrete pavement. I think I have tried every kind of concrete pavement that has been made, and the hardest has had to be first abandoned. It is no use to have a pavement which will not wear. The best is that which comes somewhere near to the York stone; but we all know that, unless tooled to a very nice degree, York stone does not of itself wear to a good surface, and York stone pavement in the south of England is costly. The Ferrumite stone was the hardest, but at Reading it was the first which had to be discarded. I have tried the East Greenwich, but it did not wear equal to the Victoria stone. The Victoria stone is, I think, the kind of slab pavement that wears the best of all. With respect to asphalte, that depends greatly, as Mr. Ellice-Clark said, upon the way in which it is used. In Reading we have an asphalte pavement, which is completely used up now, but the date of it is 1842.

That certainly is in a street which has not much traffic, but still to have been forty-five years in use shows it was good material. In another case we have had Limner asphalte down eleven years, ¾ of an inch thick. This was where the traffic was heaviest, and it had to be repaired last year. We have had this asphalte laid throughout the town, but none has been laid less than an inch thick, and I do not think it is proper, or right, that anything in the way of asphalte should be less than an inch thick. There are other things, sometimes, besides atmospheric action which affect concrete and asphalte. I found two or three liftings in the pavement of one of our main roads, where there were three inches of concrete under a 1-inch bed of asphalte. When I examined it I found it had been lifted one or two inches out of place by a bed of mushrooms. There were two or three other places close to each other which had been lifted in the same way. Originally under this was an old gutter in front of a roadside public-house, and possibly the droppings from the horses standing there may have affected the ground.

Mr. Boulnois: I desire to speak more of concrete than of asphalte pavement. In my town we have laid many miles of Ferrumite. Most of it was laid before my time, but some of it has been put down since. So far, I may say, ferrumite has proved itself to be a very valuable paving material. There is no doubt that some of the earlier samples were made with too much iron. Iron filings are used on the top surface, and in many cases too much was used, and the result has been a slippery surface. The question of the wear of compressed asphalte lies in a nutshell. Unless asphalte gets sufficient traffic on it, it will never consolidate properly. There is an instance of this at the railway station at Brussels. Where the traffic is heavy it is perfectly sound and good, and where the traffic is light it is all in pieces. With regard to the question of monoliths or slabs, the author prefers monoliths, but there are objections to them, and slabs are preferable. When repairs are required, slabs can be taken out and put back again. While the monolith is setting, too, the traffic has to be diverted, and slabs get over that difficulty. The paper we have had read is an exceedingly valuable one—just the kind of paper this Association should have, and full of really good work.

Mr. J. Lemon: I will just say a few words, and they shall be very few. With reference to the data given by Mr. Strachan, I think I may say it is to some extent misleading, because he bases

his experience on the city of London and other places where there is large traffic. About twenty years ago, I was very enthusiastic about asphalte, and my Corporation laid many thousands of yards of it. I have now come to this conclusion respecting compressed asphalte, that you must have a very large traffic upon it, or you must have sufficient thickness to keep it together. If you do not have this, then asphalte is bound to fail. My Corporation had asphalte laid by some of the best companies, but it was only ¾ of an inch thick, and the result was that the footway very soon wore out. It was no fault of the company, as the work was exceedingly well done, but they had to renew it before the term for maintenance had expired. In contradistinction to this, I may say that they also laid a carriageway two inches thick. This was fifteen years ago, and since then it has never cost a single sixpence for repairs. In the one case there was insufficient thickness and too little traffic; in the other case there was sufficient thickness and sufficient traffic, and the result was a very good and perfect road. As to concrete footways, I think that concrete laid *in situ* will be the pavement of the future, because we all know that the cost of paving in a town is a very considerable item indeed. Many miles of roads and streets would be paved by local authorities if it were not for the cost. If surveyors can, by study and experiment, perfect a good footway at a moderate cost, they will be doing good work for society. In my own town Mr. Bennett, the borough surveyor, has lately introduced blue brick pavement, which I believe costs 3*s.* 6*d.* per yard superficial, including concrete. I do not like the appearance of it myself, but it wears very well, and when you consider it is only about one half of the cost of some footways, it certainly deserves consideration. If you can lay concrete *in situ* for the same price, and I believe you can, you will have a very good footpath indeed.

The PRESIDENT: We are much indebted to Mr. Strachan for his interesting paper. The subject is a most important one, to which a great deal of attention has yet to be given. The difficulty of dealing with concrete foundations is one I do not believe we have solved. I would draw your attention whilst here to the cement pavements in this town. You will find a very extended cement concrete footway in the London road laid down *in situ*. There are also examples in Evington Street, in Church Gate, and Lower Church Gate, laid by contract by Mr. Walker of Leeds. We have in other instances employed our own workmen, and I

quite agree with Mr. Strachan that we should endeavour to do this work with our own workmen, because then we have greater control over the cement and its mixing. We have laid in this way in Welford Street a broad footway of some extent, and a similar character of footway in cement in Nelson Street and Kent Street. There are a few rather small, insignificant cracks I should like you to find for yourself. It may be due to the concrete bed on which the cement finishing is laid, but I am afraid I should be offending against the rule I have laid down if I were to go on to give my own experience in Leicester. I am sure the thanks of the Association are due to Mr. Strachan for bringing this important subject before us to-day. Although not quite new, it is always new, so long as there is anything to be learned about it.

Mr. Strachan: I am much obliged by the way in which you have discussed my paper. It will be an encouragement to members to come forward and read papers, and give the results of their experience.

CORRESPONDENCE.

Mr. John Price: In the district of Toxteth Park cement-concrete foot pavements have been laid for a period of twenty years. These pavements have been constructed in various ways and have worn fairly well; nearly all are badly cracked, and as the pavement is of a monolithic character, natural forces, such as frost, &c., cause the pavement to break up; after twenty years' use very little effect has been produced as the wear has not exceeded $\frac{1}{4}$ of an inch on the line of greatest traffic.

The method which I now adopt in the construction of these pavements is as follows:—The footway is excavated for a depth of 5 inches below finished level, and upon the formation a layer of cinders 1 inch in thickness is evenly spread; upon the cinders is spread a layer of clean hard stone, broken to pass a 3-inch ring, which is then rolled and watered, and finishing about 2 inches below finished level. The footway is then divided by battens into widths of 5 feet, and each alternate width is completed in the following manner: upon the stone foundation a layer of concrete is laid, composed of 1 part of Portland cement to 2 parts of clean coarse sand and 2 parts of 1-inch screened gravel, which is well rolled into the foundation and finished off to 1 inch below finished

level to allow for the finishing coat, which consists of 1 part of Portland cement to 2 parts of clean Oporto or Laxy gravel or other gravel of similar quality which will pass a ¼ of an inch sieve; it is then quickly rolled and finished off to the right level with a long-handled smoother. The width is then divided by neat trowel cuts parallel to the kerb into flags not exceeding 18 superficial feet to each flag; when the alternate widths have been completed and are firmly set, the intermediate widths are proceeded with, a joint of not less than ⅛th of an inch being left between each width, which is filled in with fine sand.

These pavements present a very neat, clean and cheerful appearance, and as they are executed by the Board's own staff at a cost of 3*s.* per superficial yard, which includes 12½ per cent. for superintendence, use of plant, &c., they may be said to be cheap. I estimate that the cost, roughly, is divided as follows: Cement costs about ⅓rd, manual labour ⅓rd, and gravel, sand, stone, team work, &c., the remaining ⅓rd. The price paid on the works for the materials average

	s.	*d.*	
Portland cement	35	0	per ton
Broken stone	4	6	„
1″ screened gravel	5	0	„
¼″ „ „	5	6	„
Cinders	2	6	per load
Coarse sand	3	6	per ton

If cracks could be eliminated entirely from concrete pavements laid *in situ*, then it seems to me to be the perfection of a pavement; I have not been able to get rid of all the cracks, although I have considerably reduced the number. I use nothing but the best materials, and pay particular attention to the testing of the Portland cement.

My experience of the artificial concrete flags is that unless they are laid on a bed of concrete they are very easily broken; and if you take into consideration the cost of the bed of concrete they are as expensive as 3-inch best Haslingden flagging.

Mr. Strachan, I think, must be in error as regards the weight of the cement he mentions as ground to pass a 2500-mesh sieve with 10 per cent. residue; my experience is that such cement never weighs more than 110 lbs. to the striked bushel.

Mr. STRACHAN, in writing his reply to the discussion on his paper, gives the following analysis of compressed asphalte after seven years' wear in a carriageway in the City, laid by the French Asphalte Company :—

Bitumen and Carbonaceous matter	14·40
Lime Carbonate	82·50
Lime Sulphate	·25
Magnesia Carbonate	1·00
Silica	·75
Alumina	·80
Iron Oxide	·30
	100·00

The points of importance in this analysis are the large proportion of bitumen, and the absence of any moisture. He does not agree with Mr. Vawser in the observation that the insertion of wood screeds is a cure for the effects of the movements of concrete, and quotes the experience of Yarmouth, where screeds are removed during hot weather to allow for the expansive movements of the concrete foot-pavements. The criticisms of Mr. Ellice-Clark are regarded by the writer as very valuable. The statistics of foot traffic over the concrete samples are given in the paper, and are from 7000 to 8000 persons per day. Statistics as to temperature and weather were not given, as the experiments extended over seven years (1880 to 1887), and averages or extremes over such a period do not appear to the writer to have much practical value. The suggestion of a standard to which all experiments should be reduced, is a taking one on the surface; but the writer doubts whether it would not mislead as often as it gave useful information, for the life of a pavement is not directly proportional to the traffic over it. As to the weight of cement with a residue of 10 per cent. on a 76-mesh, the writer agrees that it will be nearer 112 lb. than to 116 lb. per bushel. It is the cement leaving a residue of 10 per cent. on a 50-mesh which was stated to have a weight from 116 lb. to 120 lb. per bushel. The writer also agrees that 1 inch of asphalte gives much superior results than $\frac{3}{4}$ inch, and adds that the increased life far outweighs the extra cost, but the New Bond Street case referred to in the paper shows that $\frac{3}{4}$-inch asphalte gives very good results. The writer agrees with Mr. Boulnois that the concrete pavement makers now make much better pavements than they did seven years ago.

Experiments which extend over years are obviously open to the criticism that the present make is superior. It is only by experiment over long periods that reliable information can be gained. It seems to the writer that the value of experiment is in affording evidence of the behaviour of samples over years, and thus giving the engineer data from which he can start his estimate of the value of the improved pavements.

REFUSE DESTRUCTORS AND THEIR RESULTS UP TO THE PRESENT TIME.

By C. JONES, Assoc. Inst. C.E., Ealing.

It must be taken as an acknowledged fact that there is some difficulty in constructing a suitable furnace for burning refuse, and there is little doubt the experience of many years gained by "Fryer's Destructor" has done immense service, if not actually made this particular system a success. Turning to the several inventions brought out, it would appear at first sight that the object sought to be carried out was simple and easily to be performed; but after trials sometimes extending over two or three years, and with different kinds of refuse at different towns, they have nearly all been at last abandoned. All these trials tend to show that we must move with the greatest caution in adopting any particular process.

It will probably interest the members of this Association if a short description be given of the various inventions that have been in use, with a few remarks upon each.

Furnaces of the ordinary type were used in London districts and the northern towns over thirty years ago, but most of these were built either by contractors or those who did not consider, in a scientific way at any rate, the action of heat, and how to utilise the small combustible portion contained in refuse to burn up the larger quantity of less combustible material. The shape and general construction of the fire-brick arches was wrong, the arrangements for feeding were bad, and the flues and passages for gases were designed more by guesswork than calculation. It is therefore no wonder that these proved to be only feeble attempts to introduce the principle of fire. It was found necessary to burn coal or other fuel in these furnaces in order to dispose of the refuse as collected, and they were ultimately used only for burning paper, straw, hampers, baskets and other light materials; several are used for that purpose at the present moment. One of these furnaces was built by the Corporation of Manchester about 1873,

and many alterations were made from time to time. After three or four years' experiments (about the year 1876), Mr. Fryer, of Nottingham, appears to have come upon the scene of action and arranged with this Corporation for a trial of his furnace, which he named "the Destructor." This trial turned out sufficiently successful to induce the authorities to have another erected, and in a very short period they had no less than three large destructors built upon Fryer's patent.

Birmingham Corporation followed next; then came Leeds and Bradford. These destructors have been seen by most of the members of this Association, and called forth a very able paper from our late esteemed friend Mr. Morant (May 27th, 1880). About this date Messrs. Pearce and Lupton, of Bradford, invented a furnace for dealing with town refuse, and the Corporation (of which Mr. Pearse was then a member) allowed them 50*l.* for a six-months' trial to prove *the said* advantages of their invention. These furnaces consisted of fire-brick arches, feeding hoppers and regulating dampers, with perforated fire-brick walls at the back of each cell. The invention claimed many advantages, and especially mentioned the perforated wall for dealing with offensive gases.

The trial appears to have been conducted upon fair lines. The sanitary committee instructed one of its officials to remain with them and note the quantity of work done, the wear and tear of cells, the amount of smoke and smell given off, and the inventors were allowed to engage their own men and work the apparatus in any way they thought proper. Although several improvements were made and a fair amount of refuse burnt, they abandoned the trial.

The next invention came from "Pickard," a person who had been employed by the Leeds Corporation as foreman at the Destructor works; he called his refuse destructor the "Gourmond," and it consisted of a large fire arch with two sets of furnace bars and two furnace mouths to one cell. Although there was nothing to favour this form of cell, there was certainly one part of his invention which is of the highest importance, and that is the flues and second fires; he conducted his gases from the cells down a horizontal flue and erected two ordinary fireplaces in this flue with the fires crossing it, or the fire-bars at right angles to the flue. He had exactly the first part of the principle which has so benefited the author, viz. by the action of fire the gases given off from the cells are purified; and if he had built his furnace carefully

and made continuous practical trials, he would probably have adopted several other features contained in the "Fume Cremator," and thus have solved that part of the problem in advance.

Immediately afterwards Healey brought out his refuse furnace. Mr. Healey was engaged as assistant to Mr. Bryan when at Blackburn, and the erection of a "Fryer" was carried out at the time. An agreement was made with the makers, and a furnace called Fryer's and Healey's destructor was erected at Bradford.

The arches and furnaces were like Fryer's, and following in the steps of the two previous inventors he attempted to purify the gases. The main arch was constructed hollow over the top and the gases made to pass at the back of each cell down the sides and over the arches, and the high temperature of the arches and flues were to have destroyed the offensive gases. This, however, did not take place, and although this destructor has been altered and experimented upon at great expense, no advantages have hitherto been obtained.

Then followed "Thwaites" with a boiler and refuse furnace combined. It consisted of a vertical boiler with a hopper in the centre at the usual place for the chimney, and the heat of the boiling water and hot gases were said to prepare the refuse for combustion.

Then came "Young," of Glasgow, with his refuse furnace consisting of an ordinary furnace with closed ashpits. Air is blown into this ashpit by a powerful fan, and combustion thus facilitated. The refuse burnt is composed of paper, straw, and light materials, and is readily consumed, whilst the cinders are picked out and burnt under an ordinary boiler. The author believes Mr. Hewson, of Leeds, made the blowing of air under the ashpits a principal part of his inventions taken out last year.

The next to enter the field was Mr. Wilkinson, of Birmingham; he had considerable experience with two kinds of furnaces, viz. Fryer's destructors and Fryer's carboniser, and it was thought his inventions would contain some advantages over those already used by his Corporation. They consisted of cells with fire-brick arches and flat fire-bars, with large double furnace mouths and a perforated wall at the back of each cell, similar to that invented by Pease and Lupson. Mr. Wilkinson spoke so highly of their use that the Corporation of Blackpool were induced to erect one about two years ago. These furnaces have been found to cost a great deal for repairs, and will probably be abandoned and replaced by Fryer's this year.

The following is extracted from reports which are of sound practical value:—Blackpool Council Meeting, May 3rd, 1887. Report of deputation dealt exhaustively with the destructors and cremators which had been carefully inspected at Nelson, Burnley, Bradford, Leeds, Ealing, Richmond, and London. The conclusions of the committee were as follows :—" We suggest to the Council that our destructor be increased by the addition of four cells of the pattern made by Messrs. Manlove, Alliott and Fryer, such cells being placed on the back-to-back principle. We also strongly recommend that a 'fume cremator' be fixed in connection with the destructor, and that the heat be utilised before passing into the chimney."

Board of Works, Clapham.—One of our members, Mr. A. Southam, surveyor to the Board, has the following in his report of March 2nd, 1887 :—" Although deputations from all parts of the country have been to see the destructors at Birmingham, I am not aware that Mr. Wilkinson's plan has been adopted excepting at Blackpool ; it will therefore be necessary to obtain further information as to the relative merits of Fryer's or Wilkinson's system." On April 2nd, Mr. A. Southam reports further in reference to Birmingham, and their inspection by a deputation of his committee. He says :—" At one depôt Fryer's furnaces are in use, but at the principal yard some of the furnaces are designed and constructed by Messrs. Piercey, whilst others have been arranged and built under the direction of Mr. John Wilkinson : they are stated to be less costly than those constructed on Fryer's principle. The committee have also visited the destructor erected at Ealing and Whitechapel, which are both upon Fryer's principle, that at Ealing having as an addition 'Jones's Fume Cremator,' and they are of opinion that Fryer's destructor is superior to the Birmingham destructor."

The next inventor was Burton, who constructed a long single furnace with two fires, and the refuse was dragged through by a long endless chain, which was moved at intervals by a windlass as the refuse became consumed. It is evident that no great heat could be generated, or the chain would be burnt and the process stopped.

Then followed Stafford and Pearson, of Burnley, with the " Beehive," which is so familiar to our Members that it is unnecessary to describe its construction.

In the valuable digest prepared by Mr. Clavey, of Burton-upon-Trent, for his Board in 1886, under the head of Burnley, where the

Beehive was born, in answer to the query as to whether the destructor gives satisfaction, the reply is, "It gives every satisfaction;" but on turning to Leicester, where it was in the hands of one of our most experienced officers, the reply to the same question is as follows, "the Beehive did not give satisfaction and had been demolished."

At Bradford, "the Beehive was abandoned within three months of its erection, on account of the excessive cost of working it."

Details are given in a tabulated statement supplied by Mr. Gordon as to the experiments carried out at Leicester with the Beehive, which "did not give satisfaction." Turning to Richmond, in answer to similar questions, the reply is, "They had two Beehive destructors, which did not give satisfaction, and were closed on account of several law actions." The author took the trouble to visit the Beehive destructor at Burnley, thinking that he might be induced to have one at Ealing, and the answers just given justified the opinion he then formed. Subsequently to the opening of the Beehive at Richmond, the author was invited by the Vestry, who sought his and Dr. Tidy's advice in connection with the before-mentioned law action. The Vestry found, as stated above, that the best remedy was to close them.

The manufacturer of the Beehive subsequently introduced the "Nelson." The author has no personal knowledge of this apparatus, but one was erected in the town of Nelson as a private speculation, and like the others referred to appears to have found no great favour.

When the author took out the patent for his fume cremator, and just before it was sealed, he, very much to his surprise and annoyance, received notice of objection from the patentees of the "Nelson." However, it was a matter to be attended to, and after carefully going into the question, and consulting Mr. Aston, Q.C., one of the most eminent authorities upon Patent Law, the conclusion was arrived at that they had no ground of interference; but to ascertain without a doubt the position he occupied, he requested a friend well acquainted with the whole details to take the trouble to call at Nelson and view the destructor and ascertain in what way he had interfered with them by the construction of the cremator, when much to his surprise he received an intimation from him that "alterations were being made in connection with the Nelson apparatus which would make it very much like the cremator," so upon the strength of their proposed alterations they had served notice of breach of patent.

Ultimately, however, they withdrew their opposition, and nothing further has been heard from them. The following is an extract from a letter, of a few weeks since, from Mr. De Courcy Meade, referring to various destructors he had visited, and amongst others the Nelson. He says:—"In the latter, viz. the Nelson, case the apparatus was not at work, although I had previous to my visit been informed that it would be at work on Thursday, Friday, and Saturday. I called on the middle day, viz. Friday, and was afforded every information upon the subject. So far as I could judge, this apparatus is merely an experiment, and is used for burning slaughter-house offal. The dust of the town is shot on a field in the suburbs."

The Blackpool people say they carefully inspected it (the Nelson), but they do not recommend its adoption. The Huddersfield authorities also found it was only doing 4 tons per day, and suggested that it was still in the experimental stage, and from the figures given it costs 2*s.* 6*d.* per ton to destroy refuse which is considerably more expensive than many refuse destructors already abandoned, and we must wait a considerable time before we are able to judge of the wear and tear.

Another apparatus was invented by Hardie, of Burnley, and consists of the old saddle boiler with an inclined furnace underneath, and he proposed to do away with chimneys by adopting the air-blowing principle, somewhat like Young and Co., Glasgow.

Mr. Jacobs, borough engineer of Salford, designed a furnace for burning sewage sludge, also town refuse; but from what can be gathered, the Corporation, after investigation, decided to erect a "Fryer" in preference. Its construction was upon the limekiln model, and is illustrated in a late vol. of the 'Proceedings of the Institution of Civil Engineers.'

Next on the list is Odgen, of Burnley, with a refuse furnace constructed with two fires and a boiler over the top: he claims several advantages over all others; first, the burning of offensive gases by passing them through a coke fire, and also the carbonising of refuse and retaining its fertilising properties.

Finally, we have Orsfall, of Leeds, with an ordinary furnace with closed ashpit and the combustion maintained by a combination of steam and air being blown in under the fire-bars. This principle was tried in Manchester in 1876, and has been in use at Rochdale since 1881, under boiler furnaces that are burning screened refuse. There have been numerous other refuse

furnaces invented, but as they have not been placed before the public, there is no need to name them.

Having detailed, so far as has been ascertained, the various destructors brought before the public, it is found that at the present time there are probably not more than about thirty of every description in use in England, varying in size from two to twelve cells, and the various models actually in use, so far as can be gathered, consist of Fryer's, Healey's, the Beehive, the Nelson, and the one at Birmingham known as the "Wilkinson." Consequently the subject appears at first sight to be one of great simplicity, but a few minutes' consideration will convince every one present who has had to deal with the difficulties that gather around this matter, that it is no easy thing to reduce into ordinary space the many questions that of necessity arise. Those who are engaged in the larger towns of England, such as Manchester, Birmingham, Leeds, and London, are fully alive to the immense difficulties which have to be coped with in settling what may be called the dustbin nuisance. Whilst our towns and the suburban parts of our districts were content, and shoots were without difficulty provided, and sanitary science had not yet distended its nostrils to gather up every whiff borne upon every wind that tells its tale of what *ought not to be*, and thousands of tons of refuse garbage were transported from our neighbourhoods and dealt with as circumstances might dictate or necessity require, in somebody else's neighbourhood, it was well; but that time has passed away, and the absolute necessity of dealing with this growing difficulty has come home in a very painful manner to most of our local authorities, whether they be constituted under the powers of the Public Health Act, or the Metropolis Management Act of London.

It is during the last ten or fifteen years these difficulties have principally cropped up, and upon referring to data supplied by Mr. W. Santo Crimp, in which he includes some twenty-five towns (omitting Manchester and Birmingham, which were of still earlier date), we find amongst the early destructors erected was the one built in Leeds in 1877. The next in date is also Leeds in 1879, in Heckmondwike and Warrington in the same year. Then follow Blackburn, Bradford, and Bury in 1881; Bolton, Hull, Nottingham, and Salford in 1882; Ealing 1883; London 1884; Newcastle, Preston, and Whitechapel in 1886, and Bournemouth, Batley, Longton, and Battersea, with other towns, are now erecting

or upon the point of erecting destructors. The details from some of these towns are herewith appended, as are also experiments which are now being carried out at the Ealing Works by two Government officers.*

It was at one of the meetings of the Association at Leeds, under the presidency of the late Mr. Morant, that the author first saw Fryer's destructor, and the difficulty experienced at Ealing, not only with the house refuse but with the sewage sludge, led him to look for a remedy in the apparatus there seen at work. With the consideration which the Ealing Local Board has always shown, consent was at once given, and a 2-cell destructor was built. The author then endeavoured to settle the sludge question, and can only repeat what has been said again and again, that he found it absolutely certain in its work, and saw that he had secured a most valuable appliance, and should without difficulty rid himself of a most unendurable nuisance and continual expense. It was soon found that a 2-cell destructor was not sufficient for the purpose, and consequently the next season two more cells were erected, and at the present moment the destructor at Ealing is dealing with the sewage sludge of a population of 19,000 and the house refuse of 22,000. The adoption of this mode of dealing with sewage sludge has produced a great deal of discussion and not a little difference of opinion. This latter remark refers more particularly to the Metropolitan Board of Works, who, having heard something of what we were doing, tried some experiments for themselves, and attempting to burn their sludge in a Hoffman kiln signally failed, and Mr. Dibden states that it was the cause of offensive effluvia and could not be carried out without a nuisance, and the author cannot help expressing surprise that the Metropolitan Board of Works, with all their resources of wealth and engineering skill, should not have carried out their experiments in a more practical manner and with the best appliances that could be had. The dealing with the metropolitan sewage was a question of multiplication of power, and the author is still of opinion that the gigantic sludge barges now being built will have to give way to a more scientific mode of dealing with the difficulty than that of carrying the sludge out to sea and there precipitating it for the benefit of the finny denizens of the deep or the unfortunate passenger vessels which may be passing through this conglomeration of London filth.

* These experiments being incomplete the details are of necessity postponed.

Mr. Dibden, in his paper on "Disposal of Sewage-Sludge," lately read before the Institution of Civil Engineers, says:—"Before the *pressed* sludge can be burnt, the water must be driven off by heat. This involves a quantity of heat greater than that obtained from the combustion of a weight of material equal to that to be dried. In other words, expense for fuel is incurred plus the cost of pressing. When the dustbin refuse of a town is available, doubtless the object can be attained by the use of 'destructors.' The case of the Metropolitan sewage is, however, different, as no excess fuel is obtainable without considerable expense."

Further, Mr. Dibden goes on to say:—"He heard for the first time of Mr. Jones's invitations to Ealing. The facts of the case were simple. If the cost of *pressing* was prohibitory, as it appeared to be in the Metropolis, what was the use of considering the question of burning it? Mr. Jones did not contend that he could burn the *unpressed* sludge, but only the pressed. Therefore if it were decided to carry the sludge to sea, what good would be done by considering a point which could only be arrived at by first doing something which was not intended to be done? The cost of pressing the sludge of the Metropolitan sewage was far greater than in many other cases, in consequence of the additional quantity of lime required to be added to it, namely from 2 to 4 per cent., or from 20,000*l.* to 40,000*l.* per annum—a sum which would in itself go a long way in paying for the transit of the unpressed sludge to sea. No one doubted that small quantities of cake could be burnt without nuisance. It was a question of advisability, and not so much of practicability. By burning, the whole of the value of the sludge, whatever it might be, *was absolutely lost*; but when it was taken out to sea it served to manure our fishfields instead of our cornfields."

In the course of the same discussion, our esteemed president, Mr. Gordon, stated as follows:—

"Where land was available, it seemed to him that the Birmingham system of digging the sludge into the land was an exceedingly good one. He could not believe that the Ealing system of mixing the sludge with ashes and town refuse, with the object of partly drying it and then burning it in a destructor, was practicable on a large scale, although he thought great credit was due to Mr. Jones for first starting the idea and putting it into practical shape. For large centres of population, pressing the sludge, and then cremating it in this way, might be the best method of getting rid of it in all respects save one, namely, that of cost. For London, however, he could not

but think the Metropolitan Board was in the right in attempting to deal with the sewage in a manner which seemed to be within the range of practicability and in combination with the precipitating system to inaugurate the transport of wet sludge direct to sea, inasmuch as the difficulty of dealing with it in any other way by finding suitable land, or pressing it into a smaller bulk, to facilitate its transport, sale or otherwise, would still be very great, and attended with greater expense than taking it to sea.

"He was nevertheless of opinion that, with carefully constructed furnaces and a strong draught, almost any sludge could be effectually destroyed, if a small quantity of the cheapest coal, or turf, or even cinders or ashpit refuse were used. He had little confidence in mechanical pressure being ever found reasonably economical in dealing with the enormous bulk of sludge produced in the Metropolis and the larger provincial towns."

And at the same meeting, Mr. Bennett, of Southampton, stated as follows:—

"Up to the present time he had been able to dispose of every ton, so that the works were now paying their way without making the slightest increase in the rates. The products of combustion passing through the boiler raised the steam for compressing the air. Mr. Dibden had further stated that the scheme necessitated the control of the dustbin refuse and road-sweepings by the sewage authority. In the case of Southampton that was a fact, and he thought he could show that it was a very advantageous combination of the two systems of disposal. He thought also that it would be a great improvement if the Metropolitan Board of Works would take the sole control of the ashbin contents and road-sweepings, and put an end to the system of divided responsibility that now appeared to be adopted in London; and also, instead of following the present method of destructors, in each district or parish, erect two large destructors, one destructor on each side of the Thames, conveying all the ashbin contents and road-sweepings to the outfall works, and so utilising them for obtaining some portion of the steam power for treating the sludge. Mr. Dibden had stated that one reason against treating the sewage in any other way than throwing it into the sea, was the great expense occasioned in pressing it. Mr. Bennett thought that the ashbin contents could be so burnt that power would be obtained for treating the sludge by pressing it."

The author's general reply in connection with these several extracts, applying as they do in a most important manner to the

uses to which the destructor is capable of being applied, is shortly as follows. The author did not in his remarks at the Institution refer in the slightest degree to pressed sludge. Nor can he understand in reviewing his statement how Mr. Dibdin could so have misconstrued them. During the years the author has been burning sludge at Ealing he has never used a press, nor has he used any other fuel in the destructor than that supplied by the house refuse. A very few days after the sludge has been pumped on to the ash beds, all the draining and drying necessary has taken place, and the material burns readily. And in further corroboration the author will read an extract from Dr. Tidy's Lecture at the Society of Arts, April 14th, 1886:—

"To my mind, the destructor has reached its highest state of perfection at Ealing, from the great thought that Mr. Jones, the surveyor of Ealing, has given to it. His sludge there is mixed with house refuse, and burnt. Mr. Jones's view is that *every town produces sufficient house refuse to burn the sludge.* One has to notice the differences of destructors. I have seen a good many myself, and I should say the differences are mainly two; first, a certain escape of offensive vapours from the shaft, and I think those offensive vapours are mainly due to partial burning—the destructive distillation, as a matter of fact, of the materials, instead of their complete destruction; secondly, the escape of fine sand and such like from the shaft at certain stages of the operation. I have seen those two nuisances very well marked, and I had occasion to advise on them on more than one occasion. I cannot help thinking myself that in Jones's destructor, where he places a muffle furnace or 'fume destroyer,' as he calls it, between the furnace and the main shaft, he has, in a great measure, met those two difficulties."

The author would now call attention to one of the most valuable papers which has appeared in the scientific world upon this question, viz. the report made by the well-known scientist Dr. William Odling, at the request of the Bradford authority, who had both Fryer's and Healey's destructor at work. Those who have gone into this question closely, know that one of the difficulties to be contended with is one springing from the sensitiveness which is felt by the authorities of almost every town when the question of smell is introduced; although no one can for a moment expect that they can go into sewage works or the dustyard of any important town and find it *smelling sweet as lavender.* There does seem to be a very strong feeling that it is an impossibility to put up a

destructor without creating an intolerable stink, and there has been admittedly some slight ground for the statement. Those of you who were in the committee room of the House of Commons upon the Kensington Vestry Bill will remember the awful and heartrending accounts given by some of the opponents of the scheme as they detailed the horrors that would arise in the erection of a destructor. This apparently happened at Bradford, and so the eminent doctor was called in to decide the question. The following is his report *in extenso* with the author's reply.

The Bradford Refuse Destructors.

Extracted from the 'Sanitary World,' Oct. 3, 1885.

"Dr. William Odling, of Oxford University, having been asked by the Sanitary Committee of the Bradford Corporation to make a personal examination of the refuse destructors in various parts of Bradford, with a view to advising them how to deal with the noxious vapours which arise from the burning refuse, has made the following report, addressed to Alderman Hardaker, chairman of the Sanitary Committee:—

"Speaking generally, the process consists in setting fire to the refuse as collected, and allowing it to burn itself out. This burning is conducted in long, nearly horizontal, furnaces, called destructors; the refuse, just as it is delivered by the carts, being introduced at the slightly higher end or back of the furnace, and the ash or clinkers being raked out at the front and slightly lower end, where the fire-bars are situated. It is noticeable that the burning of the refuse is carried on without resort to any fuel other than the combustible matter present in the refuse itself; and that despite the frequently wet state of the refuse, its burning in the destructors takes place steadily and completely. The burning of the refuse constitutes further an available source of heat, actually made use of at one of the stations to raise steam for the supply of an engine used for crushing and grinding the clinkers of the refuse into a valuable mortar. It is impossible for any one not to be struck with the very efficient way in which the destructors do their work, having regard to the quantity and character of the refuse they so completely dispose of in the course of but a few hours. This continuous and rapid destruction of the town refuse as fast as collected, with avoidance of all decomposing and offensive accumulations, cannot but be of great sanitary advantage to the

town. It must be admitted, however, that the burning process as at present conducted is not wholly unattended with a discharge from the chimney-shaft of a little unconsumed vapour, which, under some conditions, may be recognised at a distance as offensive; but this offence, at the worst, is as nothing compared with the offence and injury to health which are so successfully obviated by the rapid destruction, daily effected, of tons upon tons of objectionable matter which must, in some way or other, be dealt with in the borough, as its deposit elsewhere would not now be permitted.

"The gases and vapours, &c., discharged from the chimney-shaft are constituted, in the main, of the completely burnt-out products of the combustion of the refuse, and would, if they were entirely so constituted, be entirely devoid of any possible offence. But, together with the great bulk of completely burned and absolutely inoffensive products, there is a small amount of unburnt and partly burnt vapours, which, by their varying proportion and character, suffice at times to impart to the chimney products generally an objectionable smell, recognisable at some distance away. Having regard, however, to the nature of the refuse burnt, it is remarkable how complete the burning habitually is, and how small is the proportion of incompletely burnt products emitted. The more or less objectionable products emitted in such small proportion are mainly of two kinds, and are furnished in two principal ways. Thus the fresh refuse, being introduced at the back and comparatively cool part of the furnace, is gradually raked down to the front and hottest part, over the fire-bars, where the burning is most active. In its course downwards to the front of the furnace it gets gradually dried by the heated products from the fire below it; and the vapours which it gives off in being thus dried escape for the most part unconsumed into the flues. The vapours so given off in the drying of the fresh refuse constitute one possible source of offence, though I do not consider them the principal source. They are composed chiefly of watery vapour or steam, and what little of them is not steam would be all but entirely lost in the large volume of completely burnt products passing up the chimney-shaft. But, in addition to the vapours given off in the mere drying, to which I attach only a minor importance, there are the vapours given off by the refuse as it just begins to burn; and before it gets into the condition of active burning, and is raked towards the front of the furnace. Every one knows the bad smell given by a piece of bone, for instance, burning by chance in an open fire. Strictly speaking

this smell is not due to the actual burning of the bone, but to its state of incipient burning, or destructive distillation or frizzling by heat. Similarly the town refuse, in its state of incipient burning or frizzling, gives off what are called empyreumatic vapours, which in the furnaces as at present constructed pass at once into the flues, together with a mass of inoffensive products afforded by the active burning. It is, I consider, to the escape of these empyreumatic vapours furnished by the incipient burning of the refuse, far more than to the vapours given off by its mere drying, that any complaint of bad smells proceeding from the chimney-shaft is due.

"How to deal satisfactorily with these empyreumatic vapours, as also in the way of precaution, and for other reasons as well, with the vapours given off in the mere drying of the refuse, is not an easy matter. They are the more difficult to deal with from the circumstance that, though sufficient at times to cause offence, their actual quantity in proportion to the entire volume of gaseous and vapourous products passing up the shaft is very small. One way of dealing with these vapours would be to take means for their efficient condensation; but except as a last resource or in aid of other means, I do not recommend a resort to this method. Conducted in any way it would involve expense in plant and wages, while if conducted with a view to obtain marketable products it would involve a mode of burning the refuse differing widely from the simple, and, on the whole, efficacious method now employed, and more resembling the process sometimes employed for the distillation of shale; while the entire operation would be likely to constitute anything but a profitable manufacture. Another mode of proceeding would be to take means for preventing the formation or for ensuring the rapid destruction of these vapours within the furnace itself. Encouragement is afforded for a resort to this method by the circumstance that at the present time no attempt at anything like a practical character is made to prevent the vapours escaping unconsumed into the atmosphere, and also by the circumstance that the vapours are in their nature essentially combustible, and capable of being completely destroyed by fire. Moreover, the now dispersed heat afforded by the burning of the refuse, which might be made available to effect its own more complete burning, is shown, by its partial use for raising steam, to be in considerable excess. It is further noted that the mode of feeding the destructor furnaces with refuse is the direct opposite of

that by which similar long furnaces are usually fed with fuel, and that the course of the burning is as unlike as possible the course of burning in furnaces best adapted to consume or prevent the production of smoke. Thus in smoke-consuming furnaces the fresh fuel is introduced at the front over the fire-bars, and is separated from the main flues by a length of fully-ignited fuel, over which the flame, smoke and vapour from the fresh fuel, in admixture with sufficient air introduced in various ways, has to pass on its way to the flues. But in the destructor furnaces all this is reversed, and the vapours given off in drying and frizzling of the fresh refuse pass almost directly into the main flues.

"It would not seem advisable, however, to alter the general disposition of the present furnaces, which are so efficient for their main purpose; but while still preserving the plan of introducing the refuse at one end of the furnace and raking out the clinkers at the other it would, I consider, be quite practicable by some modification in detail to comply with the essential conditions fulfilled in the best smoke-consuming furnaces. Having regard, indeed, to the nature of the refuse, and to the diluted condition of the empyreumatic vapours to be combated, the problem would not be an easy one. Still it would seem that the fulfilment of the necessary conditions might be effected by one or other of several slightly different arrangements, which I have carefully considered; and if you should see fit to put me in communication with some practical furnace constructor—one or other of those by whom your present furnaces have been constructed, for example—we should, I have no doubt, be able to devise a specific construction which would be both practical and efficacious. The chief points of what I take to be requisite or desirable are as follows —

"1. The furnaces should be of the same general form and dimensions as those at present in use. They should not, however, be built in double blocks back to back, but in single blocks, so as to be readily accessible both at back and front.

"2. The drying up of the fresh refuse in the furnaces, before its actually taking fire, should be better provided for, and the moist vapour given off by the drying, instead of being allowed to escape at once into the main flue, should be caused to pass over and through the mass of actively burning refuse. This would effect several desirable objects. The incipient burning of the refuse would, in the first place, be less and less objectionable in proportion to the dryness of this refuse. Secondly, any possible offence from

the discharge of the vapours given off in the mere drying would be provided for. Lastly, the passage of the watery vapour or steam given off in the drying, through the actively burning portion of the refuse, would tend to make this portion burn with flame, a very desirable result as an aid to the destruction of the empyreumatic vapours given off in the stage of incipient burning. At present the foreman in charge occasionally delivers, with some such view, a jet of water on to the actively burning refuse, but the continuous passage through this burning refuse of the watery vapour given off in the drying of the fresh refuse would be far more efficacious.

"3. The opening into the flues leading from the furnace to the main flue should be so situated and arranged that the smoke and vapour given off by the incipient burning, together with a sufficient supply of air, should be caused, on its way into the flues, to pass over the most actively burning portion of the refuse, and thereby get almost, if not quite, completely consumed.

"4. The flues into which the products alike of the drying, the incipient burning, and the active burning first pass from the furnace on their way to the main flue should be of some length, but of no greater size than necessary, and be constructed with a view to their being maintained at as high a degree of heat as practicable. It is to these strongly heated flues that the complete destruction of any residue of unconsumed empyreumatic vapour must be entrusted. No amount of mere heating, however, will of itself cause their destruction. They must be sufficiently strongly heated in admixture with a sufficiency of air in order to effect their burning or destruction. The flues serving for this purpose might also be made available to aid in some measure the drying up of the fresh refuse passing into the furnace."

"Refuse Destructors.

"To the Editor of 'The Sanitary World.'

"Sir,—In your edition of the 3rd inst., there appears a very exhaustive report by Dr. William Odling, of Oxford University, upon the 'Bradford Refuse Destructors,' dealing with the general purpose of the 'Destructor' and its importance from a sanitary point of view, and treating specially upon the one weak point, viz., the escape of the 'empyreumatic vapours furnished by the incipient

burning of the refuse,' and whilst pointing out the importance of some mode being devised by which these vapours may be consumed, goes on to state that 'at the present time no attempt at anything like a practical character is made to prevent the vapours escaping unconsumed into the atmosphere, and also by the circumstance that the vapours are in their nature essentially combustible and capable of being completely destroyed by fire.'

"My object in addressing you is to point out that although Dr. Odling is most thoroughly correct in the greater portion of his remarks, and has treated the question in a most complete and perfect manner, in the first portion of the above quotation he is most decidedly, though unintentionally wrong. In the year 1883, I constructed at Ealing a 2-cell Fryer's Destructor, the first erected in the South of England. My object being to deal not only with the house refuse, but also with the sewage sludge from our precipitation works. For twelve months these two cells were worked without inconvenience, but I found that they were not sufficient for my purpose, although most successful in other respects, consequently two additional cells were added in the autumn of 1884. The consequence being that the house refuse and the sludge difficulty so far as Ealing was concerned, came to an end. I could not, however, get away from the fact, as noted by Dr. Odling, that a certain amount of vapour was given off by the fresh fuel and passed into the flue without coming in contact with the fire. Daily watching the work with the four cells under heavy burning I came to the same conclusion as Dr. Odling has with respect to the Bradford destructor, that, complete as the apparatus is in itself, it requires something more to prevent the possibility of its becoming a nuisance, and that the only possible remedy was fire, the difficulty being the best mode of application. I decided not to interfere with the furnace, but to apply the remedy quite distinct, and after many experiments constructed a 'muffle' furnace, intermediate between the furnaces and the main shaft. Nothing could have been more successful. Everything coming from the cells, burnt or unburnt, has to pass through the intermediate furnace with the result predicted by the learned professor, absolute combustion. From a pecuniary point of view the results are gratifying, for whereas the said furnace is kept going at a cost not exceeding 1*s.* 6*d.* per day, the increased combustion gives additional steam for engine purposes, and by its increased draught assists very materially the combustion in the cells themselves. I may add that the Ealing Works have

been visited by deputations from all parts of the country as well as from various parts of the Continent, and a general satisfaction is expressed with the results obtained. A patent has been taken out for the invention.

"I am,

"Your obedient servant,

"CHARLES JONES, A.I.C.E.,

"*Hon. Secy. and Past President of the Association Municipal and Sanitary Engineers and Surveyors.*

"LOCAL BOARD OFFICE, EALING, W.
12*th October*, 1885."

Shortly after the author wrote to the chairman of the Sanitary Committee to which this report was made calling attention to the fact that a mode did exist for dealing with the difficulty referred to by the doctor.

In thus laying the report of Dr. Odling before the meeting, it is considered that more valuable information is given than the author can bring to bear upon the subject, and it certainly was in consequence of his remarks that the author wrote to the Bradford authorities ; and he has since been further informed that when the doctor's report was made, instead of trying to follow out his admirable suggestions, an attempt was made to try and carry out some improvements, but with little or no success. Mr. Healey formed drying chambers over the cells, and passed the heated gases from the newly charged cell over the hot fire of the adjoining one previous to passing them into the main flue ; but owing to the small dimensions and the tortuous course of the small flues for conveying the gases from one compartment to another, the draught proved utterly insufficient, and it was evident that it was not a satisfactory experiment, as Mr. Healey, instead of erecting a new furnace, endeavoured to alter and adapt his own destructor which was unsuitable for the purpose. Nothing further has been done during the past twelve months in the direction pointed out by Dr. Odling.

It will be noticed from the very first invention to the last, there have been attempts made to deal with the difficulties arising from the gases given off from burning refuse ; and besides those named with the inventions specified, there have been many schemes tried both by the authorities who have them in use and the inventors. Fryer patented a method of water spray a few years ago; the

water was distributed in a kind of shower by a revolving shaft in the centre of a chamber to which the gases were conducted like an ordinary shower bath. Another invention was introduced by an engineer in Salford who conveyed the gases over a long water channel and baffled them with revolving discs or wheels. This invention claimed not only to deodorise the gases, but would precipitate and retain the ammonia in the water or other fluid. Mr. Hewson at one time strongly recommended this invention. All these experiments and inventions point to one end, and all of them were more or less puffed up, and several corporations were unfortunate enough to give them a trial, probably led on by the sanguine statements of the makers; but we have the evidence and experience of our fellow-engineers who have worked them, which is of the greatest value to the members of this Association, and at once gives a clear and honest account of their capacity after they have left the hand of the inventor or manufacturer. In placing these facts before the meeting, the author has endeavoured to give them in a fair and practical manner, and with a desire to call attention to those inventors who have conceived the idea of passing gases through and into separate furnaces. It will, however, be seen that most of them simply suggested an ordinary coke furnace, and the author's first experiments were conducted with a fire of this kind; and although considerable power was found in such a furnace, there were many details which required further development before practical success was attained.

An ordinary furnace was found to consume an enormous quantity of coke, and at once raised the cost of treatment to more than double, and the heat generated passed away into the chimney without utilising all its power to consume the offensive yet burnable gases. Therefore it was necessary to consider how an arrangement could be contrived which would reduce the consumption of coke and would effectually destroy offensive gases, or, in other words, a muffle furnace was wanted which could be retained at a very high temperature ready to receive the vapours and gases at any time, and keep them inside it sufficiently long to thoroughly deodorise them; and all this had to be effectually done with a small consumption of fuel and with no extra cost for labour, and with no great increase of wear and tear.

In the experiments the author found gases very similar to wind, and by baffles they were conducted in any direction; and it was proved that if they could be baffled and deflected without injuring

the speed or draught, they might be kept sufficiently long in the furnace to consume and deodorise their offensive properties. It was also found by the regulated admission of oxygen that the fire could be maintained at one glowing temperature with a small consumption of coke and even breeze, and that it required very little attention. It must be left to others to say whether the author has succeeded in those very important points referred to by the following independent and disinterested authorities.

In evidence before a select committee of the House of Commons, Mr. T. Codrington, one of the Inspectors of the Local Government Board, said:—"He noticed improvements in many ways, and thought Fryer's with all the latest improvements was one suitable for doing its work, and considered the 'Fume Cremator' a very great safeguard against nuisance or annoyance, as it much increased the heat, and enabled a more thorough destruction of noxious gases and half-burnt paper and other things which escape."

Dr. Thos. Stevenson (Lecturer on Chemistry at Guy's Hospital, and Member of the Royal Commission on Metropolitan Sewage Discharge) said:—"If a Fryer's destructor with fume cremator was erected, it would not be possible to affect the health of the surrounding population, or cause the slightest nuisance of any kind or description."

Dr. Alfred Hill, President of the Society of Medical Officers of Health, spoke highly of the fume cremator.

Mr. R. Chamberlain, M.P., member of the select committee, said:—"You have taken great credit for adopting this particular plan, but the main features of this plan along with many others is that you have a fume cremator with these baffles in, you superheat your products. I think the superheating is important."

Mr. J. T. Pilditch, Surveyor to the Battersea Board, reported on March 15th, 1886, that in neighbourhoods where the destructors have been fixed, complaints have been frequently made by persons residing near thereto, of the nuisance caused by the fumes and dust given off by the shaft, owing to the quick blast from the furnaces during the period of burning, and which has often been a source of trouble to the authorities in the past. Improvements have, however, been recently made whereby the smoke and other impurities given off from the furnace, and which under the old system were allowed to pass direct into the shaft and so into the open air, are now intercepted and passed through a fume cremator and consumed, thereby effectually destroying the nuisance complained of, and

enabling the works to be carried on without inconvenience or annoyance to the inhabitants."

Dr. A. Newsholme, Medical Officer of Health for Clapham, reported April 6th, 1887, as follows :—

"The possibility of the escape of dust or soot or noxious gases seems to be entirely ensured at Ealing. Here not only house refuse but sewage sludge is burnt in the destructor, and yet there is absolutely no nuisance. The smoke escaping from the lofty chimney is white and thin, being much less dense than that escaping from the chimney of a private dwelling-house. This is owing to the fact that the smoke and empyreumatic fumes, on leaving the destructor, are passed through a fume cremator in which they are subjected to a temperature of 1500° F. The escape of noxious fumes is thus rendered impossible.

"The general conclusions I arrive at are that the disposal of house refuse by cremation is the best method for Clapham; that Fryer's destructor combined with Jones's fume cremator is the most efficient apparatus for the purpose."

Mr. Alfred Fletcher, Chief Inspector under the Alkali Acts, and Mr. John T. Harrison, Inspector under the Local Government Board; Mr. Alfred Fryer, inventor of the destructor, and numerous others, have spoken highly of the fume cremator; and the author can only follow their remarks by inviting the members of this Association to come at any time and judge of its merits themselves.

Finally, the results have entirely, so far as the destruction of the gases is concerned, carried out the view taken by Dr. Odling; and further, the whole of the machinery is worked by the steam obtained from this simple apparatus. The author need hardly remind engineers how valuable the results thus obtained may be where power is required, and the ease with which the power may be utilised as circumstances dictate.

Deputations from all parts of the country have visited it, scientific men at the head of their profession have investigated, by appointment and without appointment, at all times, and in every case the most direct and unequivocal testimony has been borne to its success.

The author feels sure he will be pardoned for touching upon this, as it is only by the experience thus gained and given out to others, that some data can be arrived at to advise fully and freely our respective Boards.

From the mass of information the author has received upon the subject, he has chosen the following as giving the principal results of the destructor, from a report by Mr. W. G. Laws, City Engineer, Newcastle-on-Tyne (Past President), for the year ending March 25th, 1887.

NEWCASTLE-ON-TYNE.

"Ashpit Cleansing and Refuse Removal.

"In my report for the year ending March 1884, this matter was treated in some detail, and figures were given of the ascertained cost, and particulars of the mode of disposal. So many applications have been received from engineers of other towns for copies of these figures, that the report for that year ran out of print, and it has been thought advisable to repeat the information in the present report, with the necessary additions to bring it up to date.

"The subject is one of growing interest and increasing difficulty, as towns enlarge in area and population, and the value of facts and figures in the possession of the engineers and surveyors of the large towns is daily more recognised, and, when published, they are eagerly sought after. The Association of Municipal Engineers and Surveyors is carrying on a useful work in holding meetings in the chief towns of the kingdom, where papers on this and kindred subjects are read and discussed, and the actual work inspected and criticised, and the results published in their annual Transactions. New and improved systems are thus early seen and made known, and their merits canvassed by practical men, who are all working in the same direction, and what is of even more importance, failures are quickly recognised, and useless expenditure prevented in other places.

"Corporations and Local Boards who are daily spending money in sanitary works, should insist on their surveyors not only being members of the Association, but also attending their meetings, where they will get valuable information and experience which is nowhere so cheaply attainable.

"The cost of refuse removal in Newcastle, for the past year, has been 16,205*l.*, viz. :—

	£
Removal of ashpit refuse	6,476
„ „ street refuse..	9,729
Making a total of..	£16,205

Which represents an amount of 124,010 tons of refuse of all sorts dealt with during the year.

"This may be divided as follows:—

	Tons.	Cost.	Cost per ton.
			s. d.
Ashpits and night soil	79,873	6,476	1 7½
Street sweepings	19,842	7,829	5 1½
Road slurry and dust	10,634		
Box ashes	13,661	1,900	2 9½
Total	124,010	16,205	2 7¼

"The average cost of refuse removal has, therefore, been 2*s.* 7¼*d.* per ton, or,

	Cwt.	Cost.
		s. d.
Per head of population:—		
(158,000 estimated)	15·7	2 0½
Per house:—		
(22,900 estimated)	108·3	14 2

Which may be divided as follows per head of population and per house:—

	Per Head.		Per House.	
	Cwt.	Cost.	Cwt.	Cost.
		s. d.		s. d.
Ashpit refuse and house refuse proper ..	10·2	0 9¾	69·7	5 8
Street sweepings, road slurry, &c.	3·9	0 11¾	26·7	6 10
Box ashes and shop refuse, &c.	1·8	0 3	11·9	1 8
Total	15·7	2 0½	108·3	14 2

"The refuse has been disposed of in various ways, viz.:—

"1. Sent by rail to farmers as manure.

"2. Deposited at the manure depôts, and afterwards led away by farmers, usually at a charge to them of threepence to sixpence per load.

"3. Deposited in various tips within the city.

"4. Burnt at the Byker Refuse Destructor.

"Manure has been sent by rail, as follows:—

To Chathill, on the north	46 miles
„ Prospect Hill, on the east	6 „
„ Haltwhistle, on the west	37 „

"The amount received for the sale of manure has been 148*l.* 17*s.* 5*d.*, and the cost of such sales, 64*l.*; the balance of 84*l.* 17*s.* 5*d.* has been deducted from the cost of collection, leaving the nett cost 6476*l.*, as above.

"The quantities thus disposed of have been:—

	Tons.	Tons.
MANURE—BY RAIL TO FARMERS—		
Ashpit stuff	51,490	
Street sweepings	5,250	
		56,740
Led to depôts and fields	..	9,680
REFUSE NOT AVAILABLE AS MANURE—		
To tips *within* the city.		
Street and road slurry	25,226	
Box ashes, &c.	6,986	
Ashpit material	18,298	
		50,510
BURNT AT THE BYKER DESTRUCTOR, from June 23rd, 1886, to March 25th, 1887—		
Box ashes	6,675	
Ashpit refuse	405	
		7,080
Total	..	124,010

"REFUSE DESTRUCTOR.

"The destructor at Byker was lighted on June 23rd, 1886, and has been burning regularly ever since. A careful account has been kept of the results of the nine months' working up to date, and the cost thereof, and is now given, viz.:—

Capital cost of 6-cell destructor, with roads and lines complete for 12 cells	£5059
Cost of working:—	£
Labour	207
Maintenance and repairs	21
	£228

"During the nine months, the amount of refuse destroyed has been 7317 tons, viz.:—

	Tons.
Box ashes and shop refuse	6675
Ashpit refuse	405
Market refuse	210
Condemned meat and infected bedding, &c.	27
	7317

"The amount received for burning private refuse delivered at the destructor, by tradesmen and others, has been:—

	Tons.	Charges.		
		£	s.	d.
Shop and other refuse	245	4	1	8
Condemned meat, bedding, &c.	27	0	9	0
Total	272	4	10	8

"The sales of clinker and ashes have been:—

	Tons.	Price.	Amount.		
		d.	£	s.	d.
To Corporation for Sewer and Street Work—					
Clinker	157	4	2	12	4
Ashes	377	8	12	11	4
„ Contractors and Builders—					
Clinker	417	..	4	6	6
Ashes	204	..	7	3	4
Total	..	..	£26	13	6

"Thus the nett cost of burning 7317 tons of refuse has been:—

	£	s.	d.			
Labour	207	0	0			
Repairs	21	0	0			
				228	0	0
Less *receipts* for:—						
Material burnt	4	10	8			
Products sold	26	13	6			
				31	4	2
Nett cost				£196	15	10

And $\frac{\text{nett cost } 196l.\ 15s.\ 10d.}{\text{tons burnt } 7317} = 6\frac{1}{2}d.$ per ton.

"This, of course, does not include interest on capital, which amounts to 177*l.* per annum on the total capital of 5059*l.* If this be included, the total cost per ton would be increased to rather over 1*s.*" (*This amount evidently does not include the repayment of capital.*)

Mr. Hewson, borough engineer of Leeds, has supplied the following details; they are for the year ending August 1884, but are so comprehensive that I include them as a valuable addition to the general information.

LEEDS.

"Statement showing the cost of working the destructors, during the past year, and the quantities of materials consumed by each during that time:—

BURMANTOFTS.

Year ending August 31st, 1884.

Expenditure.	£	s.	d.	Receipts.	£	s.	d.
To Cost £7282 1*s.* 1*d.* repayment of debt by equal annual instalments of principal and interest during 60 years @ 3½ °/₀ ..	291	17	9	By Mortar	97	18	11
„ Labour for 1 year ..	585	1	0	„ Charcoal	20	9	6
„ Lime	34	18	4	„ Scrap iron	14	15	11
„ Depreciation at 2½ per cent. covering repairs	182	0	6		£133	4	4
„ Gas, water, rates, &c.	126	19	7	Balance	1087	12	10
	£1220	17	2		£1220	17	2

"For this depôt the following men are required:—

1 foreman, who acts as engine driver.
6 furnacemen, working shifts of 3 in night and 3 in day.
1 labourer, who attends to two mortar mills.

"Materials consumed during the year ending August 31st, 1884:—

Tons of rubbish	1,538
Tons of ashpit refuse	23,207
Beds	45
Mattresses	96
Pigs	58
Cows	9
Sheep	9
Quarters of bad meat	4

"Statement showing the cost of working the destructors, during the past year, and the quantities of materials consumed by each during that time:—

ARMLEY.

Year ending August 31st, 1884.

Expenditure.	£	s.	d.	Receipts.	£	s.	d.
To Cost £7466 9s. 10d. repayment of debt by equal annual instalments of principal and interest during 60 years @ 3½ %	299	6	4	By Mortar	358	7	1
„ Labour for 1 year ..	579	17	0	„ Scrap iron	16	3	8
„ Lime	69	16	10		£374	10	9
„ Depreciation at 2½ per cent. covering repairs	186	13	3				
„ Gas, water, rates, &c.	81	1	10	Balance	842	4	6
	£1216	15	3		£1216	15	3

"For this depôt the following men are required:—

1 foreman, who acts as engine driver.
6 furnacemen, working shifts of 3 in night and 3 in day.
1 labourer, who attends to two mortar mills.

"Materials consumed during the year ending August 31st, 1884:—

Tons of ashpit refuse	20,019
Mattresses	12
Pigs	16
Cows	1

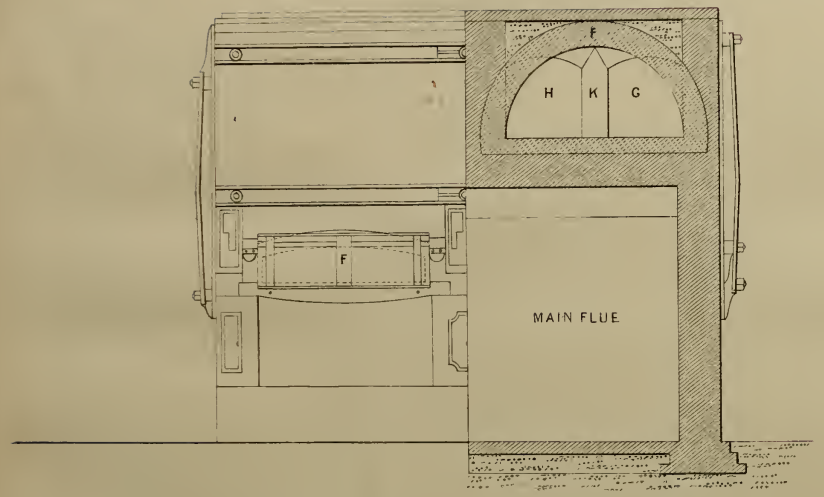
"Total materials consumed in both destructors during the year ending August 31st, 1884:—

Tons of ashpit, &c., rubbish	44,764
No. of beds	45
„ mattresses	108
Carcases of pigs	74
„ „ cows	10
„ „ sheep	9
Quarters of bad meat	4

"At a total cost to the borough, including interest and sinking fund, of 1929*l.* 17*s.* 4*d.*, or a cost per ton of 10¼*d.*

FRYER'S PATENT DESTRUCTOR FURNACE.

BACK TO BACK

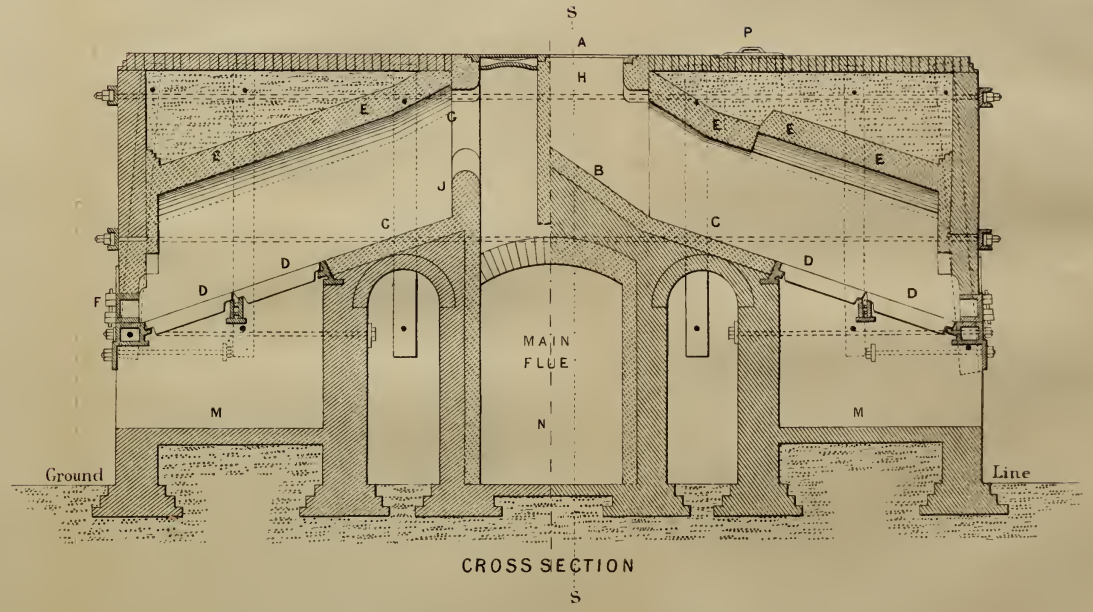


HALF ELEVATION

HALF SECTION
AT S S

REFERENCE.

- A *Refuse fed Opening*
- B *Incline above hearth*
- C *Drying Hearth*
- D *Fire Bars*
- E *Reverberatory Arch*
- F *Clinkering Doors*
- G *Opening for Gases*
- H *Opening for Refuse*
- J *Bridge to keep Refuse out of the Flue*
- K *Wall to divide Gases from Refuse*
- M *Ash pits.*
- N *Flue to Chimney*
- P *Mattress Opening.*

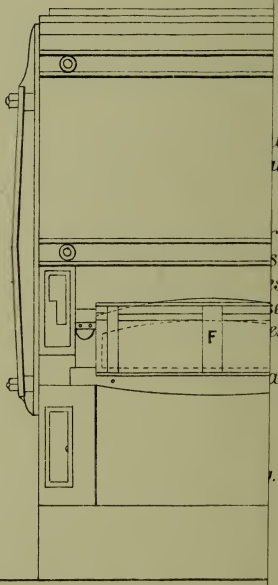


CROSS SECTION

Scale ¼ Inch 1 Foot.

DEST

BACK TO BA



HALF ELEVATI

Scale ¼ In

"It will be seen from the foregoing that the destructors have proved useful for the destruction of diseased carcases and bad meat.

"It is estimated that there are still 23,571 tons of refuse collected which are not now dealt with at the destructors.

"The construction of the destructors and carboniser at Burmantofts is as follows:—

"The destructor consists of ten compartments or cells (five back to back) formed of brickwork lined with fire-bricks, and tied with iron rods; it occupies a space of 36 feet by 24, and 12 feet in height, and is so arranged that there is one inclined road leading from the adjoining road up to a platform against and higher than the top of the destructor, on to which the refuse is carted; and another inclined road leading from the same adjoining road down to the level of the firing floor, by means of which the mortar, charcoal, old iron, &c., are carted away. At the Armley Road Destructors, this low road also leads to a tip at the canal side, where manure is barged away.

"Each of the cells is capable of destroying 6 tons of refuse in twenty-four hours, and consists of a sloping furnace with hearth and fire-grate covered in by a reverberatory arch of fire-brick, with one opening at the top for the admission of the refuse, and another opening at the side near the top for the gases to escape into the flue, and a furnace frame and doors for the withdrawal of the clinkers. The refuse, which is tipped from the platform on to the top cells, is pushed down the incline or throat with a long iron prong and slides forward on to the sloping hearth, whence, when sufficiently dry, it is helped forward on to the fire-bars, where it burns somewhat fiercely, the fire-brick arch above concentrating the radiant heat upon it. The opening for the entry of refuse is divided from the opening for the exit of gases by a partition wall, with a bridge. These prevent the refuse which is heaped up immediately below, from finding its way into the flue also. At intervals of about two and a half hours the clinkers are withdrawn through the furnace doors, but the charge of refuse is maintained permanently at the top. The effect of this is that no doors are required, the charge keeping down all smoke. The result of the process is that everything is consumed, or converted either into clinkers or a fine ash. Every two cells are also provided with an opening (with doors) for the introduction of infected mattresses, diseased meat, &c., on to the fire, where everything is readily consumed without causing a smell in the works.

"The gases from the furnaces on the way to the chimney-shaft pass through a multitubular boiler, 6 feet diameter, 10 feet in length, and make steam to drive a horizontal engine with 12-inch cylinder and 2 feet stroke, which works two mortar mills with pans 8 feet diameter. In these the clinkers made in the destructor are mixed with lime, and ground into an exceedingly strong mortar, which is readily sold at 5*s.* per ton. No fuel of any kind is required, the ashes mixed with the refuse being amply sufficient. The old tins and iron which have passed through the furnace are sold for old metal at from 5*s.* to 15*s.* per ton; but if collected and sold unburned, they fetch 1*l.* per ton, this is on account of the solder value saved by non-burning.

"The clinker from the furnaces is 25 per cent. by weight of the refuse consumed.

"The carboniser is not now used, but formerly it was used to convert the refuse obtained from the vegetable markets and other collections into a rough charcoal."

In connection with the Leeds works, the following interesting report has also recently been made: the object of the experiments was to ascertain whether the complaints made of offensive vapours, &c., from the destructors, were proved or disproved by analyses and tests of the effluent gases.

"BOROUGH OF LEEDS.

"*January* 1887.

"*Report to the Sanitary Committee of the Leeds Town Council, on the Gases and Products passing from the Destructors at Burmantofts and at Armley, as taken from the main flue leading from the Furnaces.*

"GENTLEMEN,—In accordance with the resolution of the Committee, I have made a number of tests at each set of destructors:—

"Visits were made to Armley on the 13th, 16th, and 20th December last, and to Burmantofts on the 11th, 23rd, and 29th December, and on the 10th, 17th, and 19th of this month.

"Tests were made on three days at the Armley destructor, and on three days at Burmantofts; the other visits to Burmantofts were simply visits of inspection.

"It is evident without any chemical tests that the products of combustion must vary according to the material burnt, and according

to the rate at which it is attempted to burn it per square foot of fire-bar or grate surface.

"The regularity and care with which the furnaces are fed and attended to by the stokers, has also a most important bearing on the emission of imperfectly burnt products of combustion. Further, when the material to be burnt is unusually wet, the drying must take a longer time, and may involve a slower working of the furnaces than when no excess of moisture is present.

"The following are some particulars of the quantities, &c., of the gases passing from the destructors, the observations being made at the bottom of the chimney-shafts.

	Armley.	Burmantofts.
Temperature of the flue gases	average 520° Fahr.	400° Fahr.
„ „	highest 650° „	460° „
„ „	lowest 475° „	240° „
Approximate velocity in feet per second	32	34
Sectional area of the flue or shaft ..	27·5 sq. ft.	32 sq. ft.
Cubic feet of gas passing per second	880	1088
„ „ „ per hour ..	3,168,000	3,916,800
Tons of air per hour	57·2	80
Tons of material burnt per hour ..	2·5	2·5
Ratio of air to material, or tons of air to 1 ton	22·8	32
Ratio of same in ordinary boiler furnaces	about 24·0	
„ „ with blower	18·0	

Analysis of the Gases from the Destructors at Armley and Burmantofts, Leeds.

"The composition of the gases varies considerably at different times, but the following may be taken as approximate averages:—

"100 volumes of the gases contain:—

	Armley.	Burmantofts.
Oxygen	17·42	18·11
Carbonic acid	2·32	1·24
Nitrogen	80·26	80·65
	100·00	100·00

"These results may be otherwise stated:—

Common air	87·10	90·55
Carbonic acid	2·32	1·24
Nitrogen	10·58	8·21
	100·00	100·00

"The gases also contain in minute quantity:—Sulphurous and sulphuric acids, ammonium salts, volatile organic matter, and solid particles in suspension consisting of the finest flue dust which is not deposited in the flue.

"The proportions of these substances vary very much at different times, but so far as my experiments show they are rather greater at the Burmantofts destructor than at Armley. As worked at present the latter appears to be the more efficient apparatus.

"On one occasion, when the gases were probably more impure than at other times, tests made at Burmantofts gave the following results, stated in grains per 100 cubic feet:—

Ammonia	0·1
Nitrogenous organic matter	0·6
Sulphurous and sulphuric acids	18·0
Total organic matter .. .. about	7·0

"Part of this organic matter may be present in the flue dust which passed with the gases into the testing apparatus.

"To secure perfect destruction it would be well if the gases, before passing to the shaft, were passed through a chamber containing red-hot fuel.

"This chamber might be either fed with gas coke, or perhaps with the red-hot clinkers withdrawn from the destructors which still contain some combustible matter. In the latter case, perhaps, two chambers worked alternately would be required.

"The organic matter sometimes found in the flue gases is most probably due to the drying of the materials before they are drawn down to the fire-bars to be burnt. If the material could be dried on a hot plate or bed above the furnaces, so arranged that all the air passing over the material, and vapour arising from the drying, was afterwards passed into the furnace, which would receive all its air in this way, then the risk of offensive products from the drying would be diminished or entirely prevented.

"It is very probable that the fine flue dust, which has an irritating effect on the nasal and air passages of persons breathing air containing it, is the cause of part of the complaints made respecting the destructors.

"The chamber filled with red-hot fuel would have but little or no effect in regard to this flue dust, which would be best remedied by the use of a spray of water through which the gases might be made to pass. This water spray would also tend to condense some

of the sulphurous acid, and would wash and cleanse the gases. As it would also lower their temperature, efficient draught would have to be secured by special means.

"(Signed) THOMAS FAIRLEY, F.R.S.E."

EALING.

Disposal of sewage sludge and house refuse, &c., for the year ending March 25th, 1887 :—

DETAILS OF QUANTITIES AND COST.

	Tons.
Quantity of dust, house refuse, &c., received at works during the year 1886. This includes the dust tipped direct to the destructor, about two-thirds of total amount received	3267
Quantity of sludge (after deducting 50 % for moisture drained off) produced per annum from the population of the district	4421
Total of ashes and sludge when mixed, per annum	7688
Quantity of ditto carted away by market gardeners per annum	1565
Net quantity of sludge and ashes to be dealt with by destructor	6123

Annual working expenses as below £230 3 10

$$\frac{230l.\ 3s.\ 10d.}{6123} = 9d. \text{ per ton nearly.}$$

ABSTRACT OF EXPENSES AND RECEIPTS.

	£	s.	d.			
Labour	380	0	0			
Coke breeze	36	8	0			
Repayment of loan and interest on prime cost of destructor shaft, &c. ..	115	13	4			
				532	1	4

CREDITS.

	£	s.	d.			
The heat from destructor and cremator gives us sufficient steam to work our machinery, thus saving 6 chaldrons of coke per week. 3*l.* 6*s.* per week for 52 weeks	171	12	0			
1960 yards of hard clinker (25 % of material put into destructor) @ 1*s.*	98	0	0			
Sale of rags, bottles, &c., from dust	32	5	6			
				301	17	6

	£	s.	d.
Total working expenses	532	1	4
„ saving	301	17	6
Annual working cost	£230	3	10

Gross annual expenses in connection with the treatment of sewage sludge and ashes combined:—

LABOUR.

	£	s.	d.	£	s.	d.
3 men stoking and feeding, 2 at day and 1 at night: total time .. 21 days 2 hours @ 3/10	4	1	3			
1 man screening ashes 3 „ 0 „ „ 3/8	0	11	0			
1 „ „ „ 3 „ 0 „ „ 4/2	0	12	6			
Sludge:				5	4	9
1 man loading trucks 6 „ 0 „ „ 3/8	1	2	0			
1 „ „ „ 6 „ 0 „ „ 3/4	1	0	0			
				2	2	0
				£7	6	9

The foregoing represents the house refuse and sludge which taken together give

$$7l.\ 6s.\ 9d. \times 52 \text{ weeks} = 381l.\ 11s., \text{ say } 380l.$$

The above statement as to labour includes more than should really be charged to the destructor, as the men are engaged part of the time in the yard, pumping out and other general work. Half the foreman's time is also charged to destructor.

For about six weeks in the year the fires are banked up, and there is little labour on the destructor; but no credit is taken for this; nor is there for the hard core from dust, such as tins, &c., although the labour of picking over is charged in "expenses."

The furnaces are seldom banked up on Sunday, but when this is done the furnaces are filled with refuse and the dampers nearly closed.

Cost of destructor, &c.:—

	£	s.	d.	£	s.	d.
Chimney-shaft	730	0	0			
Cost of 4 cells, fume cremator, and boiler	1270	0	0			
				2000	0	0
				£	s.	d.
Repayment of principal and interest per annum on 100*l.*, 30 years at 4 %				5	15	8
Repayment of principal and interest on 2000*l.*				115	13	4

Two of our cells and the cremator were built out of current account and not out of loan, so there are no annual repayments in respect of these, but the author has included the cost in above amount. For the destructor itself, no machinery is necessary, but of course if it is desired to utilise the heat given off to raise steam, a boiler is required. Other machinery of course depends upon the requirements of the works. At Ealing there is a 6 horse-power engine which drives the liming machine, clay mixer, works lift, chain pump, special pump, &c., atmospheric ejector, sludge ram

and mortar mill, &c., and there is steam sufficient to work all the above, and additional machinery if required.

At the present time a considerable saving is being effected by using the hard clinker as a base for tar paving, thereby causing a saving of 30 per cent. Also on a concrete paving, which can be laid for 3*s.* per yard sup., York paving costing 6*s.* 4*d.* per yard sup. The finer material from ashpit, which contains a good deal of recalcined lime, makes a splendid mortar mixed with 1 part of lime to 5 of ash, and the clinker when ground makes a good mortar with usual proportions. In the above account no special credit has been taken for these items.

BURY, LANCASHIRE.

The borough engineer, Mr. J. Cartwright, supplies the following details of the working of 4-cell destructor for the year ending March 31st, 1886:—

Total cost of destructor shaft, high-level road engines, mortar mill, &c.	£3500
Total number of tons of refuse burnt	6326

A staff of four men are employed, 2 at night and 2 in the day. Wages 26*s.* per week.

	£	*s.*	*d.*
The total cost of working the destructor for the year has been	438	15	6½
Credit by profit upon sale of mortar	103	10	1½
	£335	5	5

Abstract of Expense.

	£	*s.*	*d.*
To annual cost upon working	335	5	5
,, repayment of principal and interest in (say) 30 years at 4 per cent. upon 3500*l.*	202	8	4
	£537	13	9

$$\frac{537l.\ 13s.\ 9d.}{6326} = 1s.\ 8\tfrac{1}{4}d.\ \text{per ton.}$$

HECKMONDWIKE, YORKSHIRE.

Mr. T. Gledhill, town surveyor, supplies the following details of the working of a 3-cell destructor for the year 1886:—

Number of loads destroyed	1796		
Entire cost of destructor, including high-level road, chimney-shaft, mortar mill, boiler engine, &c. ..	£1512	0	0

	£	s.	d.
Repayment of loan and interest	118	17	6
Gas rates and general repairs	10	0	0
One man at 25s. per week	65	0	0
„ „ half time at 22s. per week	28	12	0
Cleaning boiler, flues, and insurance	6	0	0
Paid for lime	14	8	0
	£242	17	6

ABSTRACT OF EXPENSE AND RECEIPTS.

	£	s.	d.
As per statement of expense	242	17	6
Credit per sale of old iron, mortar, &c.	83	1	6
	£159	16	0

$$\frac{159l.\ 16s.\ 0d.}{1796} = 1s.\ 10d.\ \text{per load.}$$

Mr. Gledhill adds: "The destructor was erected under my supervision, and I have had the management of them since their construction (1879). I can testify to the efficiency of the destructor at Heckmondwike, and do not know what we should do with our refuse if we had no destructor."

The following is an extract from the report of the Sanitary Special Sub-Committee of the borough of Huddersfield. Most of the towns in which destructors have been erected were visited by this Committee and the Borough Engineer Mr. R. S. Dugdale, and full particulars obtained. The summary of the information obtained is from thirty-one towns, twenty-seven of them being towns referred to in the Registrar-General's Returns.

REPORT TO THE CORPORATION OF HUDDERSFIELD.

"1. *Population of District.*—This ranges from 15,000 to 545,320.

"2. *Area of Ditto.*—From 406 to 18,499 acres.

"3. *Rateable Value of Ditto.*—From 40,000*l.* to 3,395,804*l.*

"4. *Number of Towns in which Destructors are established.*—Eighteen: of which twelve have adopted Fryer's Patent; two of them, Birkenhead and Burnley, the 'Beehive' type; one, Nelson, Richmond and Co.'s; and three, Glasgow, Birmingham, and Manchester, their own design. The aggregate number of cells being 149 and four carbonisers. Manchester has, in addition, thirteen destructor boilers by Galloway and Sons.

"5. *Number of Towns having Destructors capable of cremating Ashpit Refuse.*—Sixteen. The two destructors incapable of this are at Birkenhead and Burnley.

"6. *Proportion of Population served by Destructors.*—This varies from one-fourth to the whole.

"7. *Number of Tons of Refuse destroyed per Day.*—From six to seven tons per cell per working day of twelve hours.

"8. *Reduction in Bulk and Weight.*—To about 25 per cent. and 33 per cent. respectively.

"9. *Employment of Residuum.*—In road foundations, making mortar, and filling hollows in land.

"10. *Difficulty in disposing of Old Iron, &c.*—This question is answered about equally in the affirmative and negative.

"11. *Distance which Refuse is carted to Destructors.*—This may be set down at 1½ miles.

"12. *Contiguity of Dwelling-houses to Destructors.*—Dwelling-houses and works are contiguous to several of the destructors.

"13. *Complaints.*—Out of the eighteen towns possessing destructors, seven have had complaints regarding them, but with the exception of Bolton, none of these seem to have had a more serious result than to cause means to be adopted for burning the gases before they pass into the chimney.

"14. *Height of Chimneys.*—This varies from 60 feet to 260 feet. One chimney only is 60 feet, viz.: that at Nelson, where the works are, as yet, more or less experimental. No doubt local circumstances and requirements determine height of chimney.

"15 and 16. *Cost and Royalty.*—Answers to these queries differ so far as to be of little use to the Committee.

"17. *Number of Men and their Wages.*—Apart from attendance at mortar mill or other machinery, it may be taken that five, or at most six cells, require two firemen. Rate of wages varies.

"18. *Utilisation of Waste Heat.*—In eight cases the otherwise waste heat is utilised for generating steam for motive purposes connected with the works.

"19. *Circumstances which led to adoption of Destructors.*—In most cases the difficulty of finding tips for the refuse, or other means of disposing of it.

"20. *Deposit of Ashpit Refuse on Building Land.*—In many cases ashpit refuse has been deposited upon building land, and in some of the towns this is still done. Complaints, however, appear to have been frequent, and in certain of the towns a layer of concrete 12 inches thick over the site of intended buildings is exacted. In others the refuse is covered with virgin earth to a considerable depth.

"21. *Closet or Privy system in Use.*—This is marked by variety

and embraces nearly every kind from the primitive privy and midden to the modern w.c. Several thousands on the pail system with its dry ashes places being amongst the number."

The Committee further state that "a properly constructed destructor need be no nuisance."

No reliable information can be given as to cost of erection, it being so much affected by site, height of chimney, level of ground, &c. In some cases it may be necessary to construct an inclined road to top of furnaces, in other cases the ground may be so situated as to render this unnecessary. Then with reference to the chimney. The cost varies very much for this class of work, but would probably be nearly 30 per cent. cheaper in the north of England than in the south, for whereas the cost of a shaft at Leeds 150 feet high is given as 474*l*., the one at Ealing (Middlesex), only 143 feet in height, cost 700*l*.

In some towns the residuum from destructors is ground into mortar and sold ready for use at prices varying from 5*s*. to 7*s*. per ton; at Bury, where 5*s*. per ton is charged, the estimated profit in 1886 was 103*l*. 10*s*.

The author finds a very considerable difference in the cost of burning per ton of refuse; this is also dependent very much upon original cost, also upon quantity consumed. To give an approximate idea, he has taken the following towns as examples :—

		Per Ton. s.	d.
Bury	6,000 tons burnt in the year.—Net cost of burning	1	0¾
Ealing	6,000 „ „ „ „ „	0	9
Heckmondwike	2,000 „ „ „ „ „	1	10
Newcastle.. ..	7,317 „ „ „ „ „	1	0
Leeds	44,764 „ „ „ „ „	0	10¼

These several amounts (with the exception of Newcastle, see Report) include repayment of principal and interest, allowance being made for profit derived from sale of mortar, &c., the variation in cost arising almost entirely from difference of repayment. In the case of Ealing the destruction of sludge must be taken into consideration in any comparison made; at the same time it is only right that attention should be called to the credit taken in the account of profits upon the Ealing Works in the matter of steam. The author considers this a perfectly legitimate credit, an absolute saving being effected in coke, the said coke being for engine work connected entirely with the sewage works, and not with the destructor, as is the case in the Leeds and other works, where the power is used in working mortar mills, a credit being taken in the accounts for mortar sold.

LEICESTER.

DATA SUPPLIED BY J. GORDON, ESQ., C.E., RELATIVE TO THE WORKING OF THE BEEHIVE DESTRUCTOR.

Date.	Refuse burnt.	Ashes remaining afterwards.	Actually consumed.	Coals used.	Coke used.	Hours burning.	Labourers' time.	Cost.				
								Coke.	Coal.	Labour.	Cartage.	Total.
	Ton cwt. qrs.	Ton cwt. qrs.	Ton cwt. qrs.	Ton cwt. qrs.	Ton cwt. qrs.	Hrs.	Hrs.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
Sept. 4 to 8	16 10 0	7 5 0	9 5 0	0 4 2	1 4 2	..	45½	0 11 0	0 2 10	0 18 11½	0 7 6	2 0 3½
,, 9 & 10	5 19 2	2 19 2	3 0 0	0 2 0	0 10 2	16½	32½	0 4 9	0 1 1	0 13 6½	0 3 0	1 2 4½
,, 15 to 20	33 13 2	18 15 2	14 18 0	0 7 0	2 1 0	119	129	0 18 6	0 4 3	2 13 9	1 3 6	5 0 0
Oct. 14 to 18	20 0 0	10 0 0	10 0 0	1 5 0	0 6 0	63	67	0 2 6	0 7 6	1 7 11	0 7 0	2 4 11
,, 20 to 24	24 8 0	17 5 0	7 3 0	0 17 2	0 9 0	94½	99½	0 3 9	0 5 4	2 1 5½	0 14 6	3 5 0½
	100 11 0	56 5 0	44 6 0	2 16 0	4 11 0	293	373½	2 0 6	1 1 0	7 15 7½	2 15 6	13 12 7½

Cost per ton destroyed, 2*s.* 6*d.*

WIMBLEDON LOCAL BOARD.

DETAILS SUPPLIED BY W. SANTO CRIMP, ESQ., C.E.

Name of Town.	Date of erection of Destructor.	O. D. level of site.	Height of shaft (in feet).	O. D. level of highest inhabited part of District within one mile.	Distance of nearest dwellings (in yards).	Any complaints of dust or smell.
Batley	Have just obtained sanction to loan for Destructor.					
Bath	Plans now before Committee.					
Battersea	Tenders for Destructor being advertised for.					
Blackburn	1881	430	105	625	110	Yes, from smell when burning fish offal, &c., but now have a Cremator.
Bolton	1881–2	320	180	475	50	No.
Bournemouth	Destructor is in course of erection.					
Bradford	1881	450	180	670	200	Occasionally.
Burslem	Tenders for Destructor just been invited.					
Bury	1881	350	180	405	200	Not from dust: used to from smell.
Cheltenham	Are purchasing site for Destructor.					
Derby	1882	150	160	250	300	No.
Ealing	1882	30	143	100	50	Not since "Cremator" has been in operation.
Heckmondwike ..	1879	180	..	450	40	No.
Hornsey	Land has just been obtained for Destructor.					
Hull	1882	Borough is level			80	No.
Longton	Destructor in course of erection.					
Leeds	1877	225	150	300	60	No.
Do.	1879	112	120	300	30	Complaints of dust occasionally.
Rochdale	1882	401	250	600	160	No.
Newcastle-on-Tyne	1886	184	150	204	70	No.
Nottingham	1882	82	160	190	150	No.
Preston	1886	117	180	140	40	No.
Salford	1882	102	180	139	150	No.
Warrington	1879	27	120	50	1000	No.
Whitechapel	1886	49	180	50	5	Dust occasionally (not from chimney).

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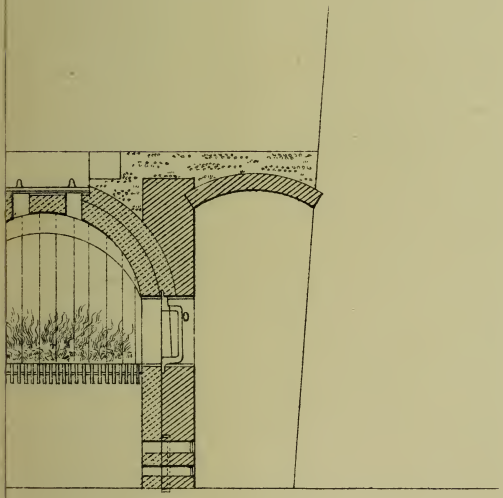
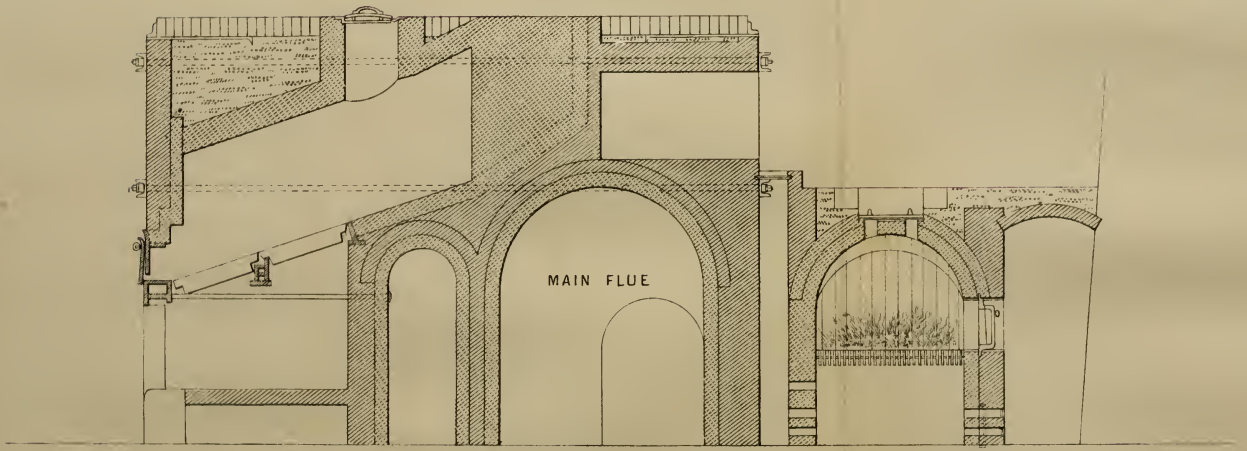


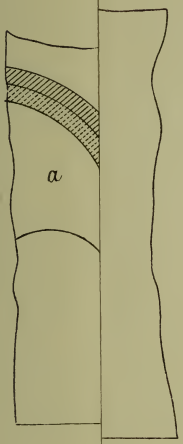
EALING DESTRUCTOR,

WITH FUME CREMATOR ATTACHED.



SECTION THROUGH CELL & CREMATOR.

Scale 4 Feet to 1 Inch.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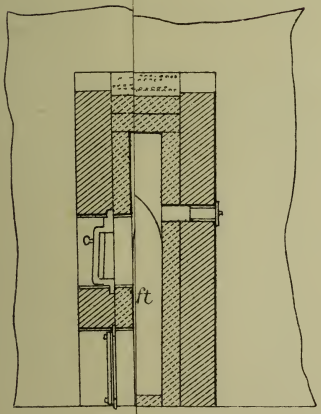
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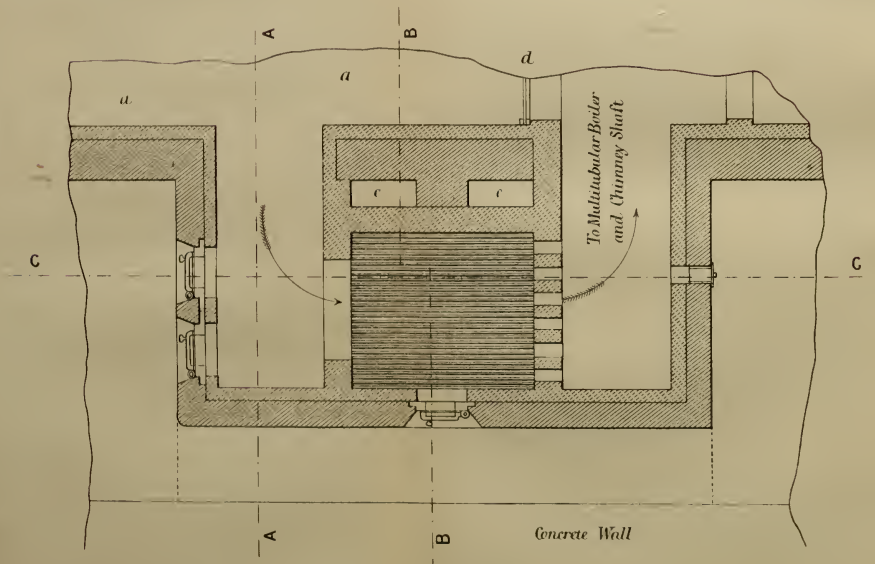
JONES'S PATENT "FUME CREMATOR"

AS IN USE AT

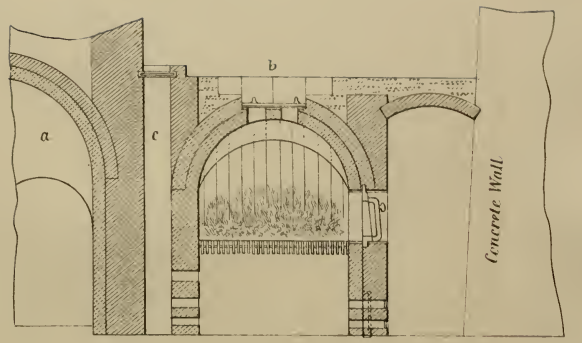
EALING, MIDDLESEX.

REFERENCE.

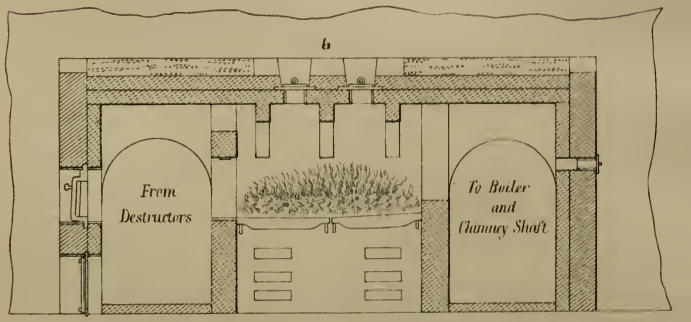
a Dust Chamber & Main Flue	*c* Air regulating Flues
b Feed Holes	*d* Iron door



PLAN



SECTION B.B.



SECTION C.C.

Scale 4 Feet to an Inch

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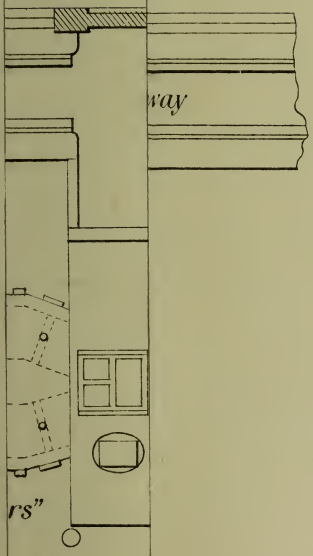
1887.



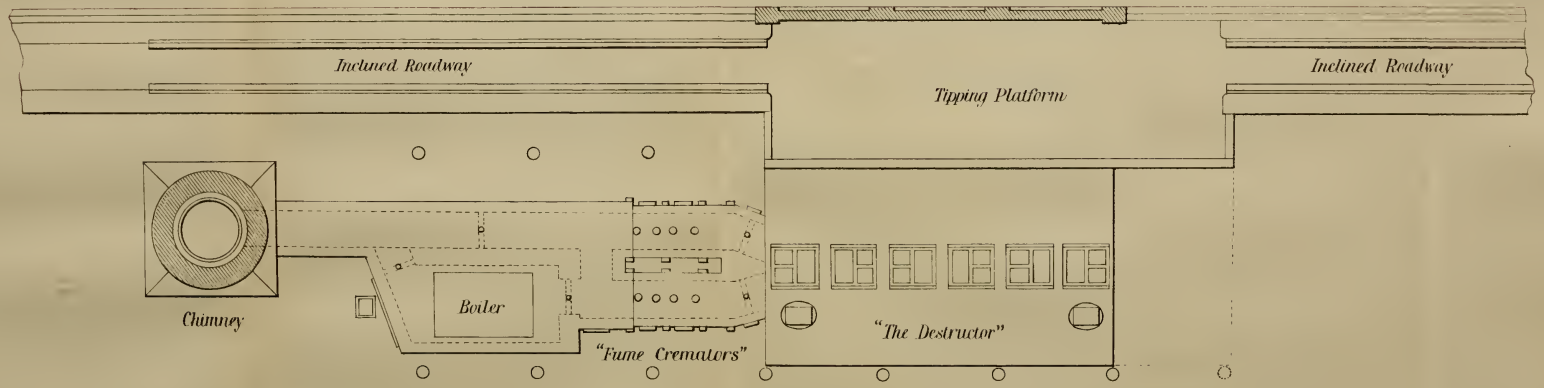
Plan of

SIX CELL "DESTRUCTOR" & "FUME CREMATOR"

ERECTED AT

BATTERSEA,

1887.



DISCUSSION.

Mr. LEMON: Our time is short this morning, and therefore I will be brief. I, together with my friend Mr. Jones, visited Leeds, and went back rather impressed with the value of the destructor; and with other members of the Town Council succeeded in getting the destructor erected to which reference has been made. At the first blush of the thing a destructor looks like an expensive and wasteful article. In Southampton the refuse was sold for about 1*s.* 6*d.* per ton. The cost of the destruction you have been told by Mr. Jones is about 1*s.* per ton. Thus the actual loss is about 2*s.* 6*d.* per ton. This is rather a large item in the expenditure of a town, but on the other side you get the advantages from the burning of the refuse. This, I think, ought not to be lost sight of. In conversation with Messrs. Fryer the other day, I found that in towns where the power generated is utilised the loss is remarkably small. I do not think, according to what he told me, that 20 per cent. of the towns in England where destructors are used turn the power generated by burning the refuse to any advantage. Now Mr. Cartwright, the borough surveyor of Bury, whom I am glad to see present, in the paper read by Mr. Santo Crimp, gives some results bearing on this point. He says 16 tons of refuse daily would enable an 8 horse-power indicated engine to be worked twenty-four hours by the steam generated. If you work this out, you will find it is ½ horse-power per ton. I think that is a very simple and useful fact to remember. In my own borough the amount of refuse burnt daily is about 50 tons, and we get about 30 horse-power, a somewhat higher result than that given by Mr. Cartwright. But you must bear in mind that the quality of refuse varies considerably during the year. I do not think Mr. Cartwright has over-estimated the power, and if you take his data, which is a very simple one, you will have something on which you can found your calculations. I have just asked the President the population of the town we are now in, and he very kindly told me it is about 140,000. If the refuse of this town were utilised you would get a useful effective power of about 70 horses. That is a thing which ought not to be overlooked; and this is to be set off as against any increased expenditure in the use of a destructor. As time is short, I will turn to the burning of sludge. I do not agree with the results of my friend Mr. Jones as to the burning of sludge. I do not think that is the

solution of the difficulty. I know from my own experience that the burning of sludge, or something equivalent to it, is attended to some extent with nuisance. In my own borough we had a very long litigation with cement manufacturers, and that was occasioned by the complaints of their works being a nuisance to the neighbourhood. On that occasion I travelled all over England to find the mode of getting rid of the nuisance; and I found the most effectual mode was to erect a furnace, which Mr. Jones calls a muffled furnace, to consume the vapour from the cement works. Now, if the burning of the mud of cement is a nuisance, under careful management, I am quite certain that the burning of sludge containing about 90 per cent. of water must be a nuisance, unless it is very carefully managed indeed. I should hesitate myself to adopt the method of burning sludge referred to by Mr. Jones. I have seen his works; they are admirably arranged and excellently managed. But as to burning sludge with the refuse, I must say I do not think it is the right thing to do. However, he gets rid of a nuisance, and that is saying something for him.

Mr. STRACHAN: Mr. Jones says that his paper in full will be included in the report of these proceedings. I would suggest that, after it has been printed and circulated, a district meeting should be held in the centre of England, and that it should then be discussed.

The PRESIDENT: I think, Mr. Strachan, this is a very good suggestion. I am almost inclined to think that it cannot possibly be discussed now. Then the question is, should it be discussed this morning? There are gentlemen present who desire to give us some information, and I would allude specially to Mr. Hewson. I do not think it is possible for the question to be fully discussed to-day; but I would ask Mr. Hewson to make a few remarks, as he might not be able to be present at the suggested district meeting.

Mr. HEWSON: I am glad of the opportunity of speaking, because I wish to do some service to the Association. I am not here to advocate any of the processes named by Mr. Jones; I am here simply to give the Association the benefit of my experience on this subject, to state what the Leeds Corporation have done. You have been told the Corporation of Leeds were the first Corporation that built destructors. About the working of these destructors, the management of them, and my experience of them, I think I can give a few useful notes, to those who have destructors but have not had much experience, and those who may have destructors.

At Leeds we had no sooner built the destructor than of course there were complaints of the disagreeable smell from the chimney. I ought to say that the destructor is built practically in the centre of the town, where there is a dense population ; and you can readily conceive, if there were any cause of complaint, we should soon hear of it. There being cause for complaint, we did soon hear of it. The Corporation naturally endeavoured to remedy the evil, by raising the chimney. But that did not remove the evil. There were still discharged out of the chimney quantities of disagreeable fumes and dust. For a certain distance around the works, according to the direction of the wind, there was a sort of salting and peppering constantly going on. From that time to the present this difficulty has existed, and to get rid of it has been the primary object of the different experiments we have made. To get rid of this dust, we first of all made recesses in the horizontal flue which passes between the two rows of furnaces. The flue I ought to tell you is something like 6 feet wide, with sunk recesses, on the right and left forming store chambers for the dust passing along to deposit in. We found this did not answer because of the smallness of the provision. We found, indeed, that after two days these chambers were filled with dust, and the nuisance was as bad as ever. The result to-day is this :—We make these recesses in the bottom of the flue as large as we can, but every Sunday we clean out the bottom of the shaft ; that is, the bottom of the chimney. Notwithstanding that we make the horizontal flue the length of this room, the 6-foot chamber at the bottom of the chimney-shaft after a week's work is pretty nearly stopped up. In fact, there is a struggle between the draught and the specific gravity of the dust ; until there is only just enough space to allow the heated fumes to escape, no doubt bearing with them a great quantity of dust. Well, gentlemen, this dust difficulty remains with us until to-day. With a view of getting rid of it we visited Mr. Jones's crematory at Ealing a fortnight ago, and were very pleased with the result. We were told by Mr. Jones that he got a very high heat—1500 degrees, whereas at Leeds we only got 700 degrees. Therefore his crematory is very complete, because if you get a furnace at 1500 degrees, through which these fumes have to pass, you will necessarily get a great deal more perfect combustion. That I think will be patent to all of us. With regard to the nuisance of the smoke, there is another thing we have found it necessary to do, and that is to watch very carefully the charging. The men very much preferred to charge the

ten or twelve cells right away, and then light their pipes and go and skulk for an hour or two. They preferred that system to the one we have now adopted in Leeds of charging only a pair of cells at a time. We used to charge the cells as quickly as the men cared to do it, every 2½ hours. The cells are back to back, and we now make them charge every twenty-four minutes. The result is that we do not have coming out of our chimney-stack for half the time, large volumes of disagreeable fumes from the cells being charged regularly. Only a very small quantity is now visible. By this system, too, we get a more uniform heat. Under the old system, immediately after the general firing the temperature went down 150 degrees. Among the other things we tried to secure better combustion was that of making a great number of holes in the fire doors, so as to let in a quantity of oxygen *over* the fire, and to make this more effective we put in bafflers on the soffit of the arches. These we secured to the arched roof by pieces of sheet iron, which would have the effect, when the current passing through these holes struck against these bafflers, of throwing it down upon the fire. These were very useful, and the two things together did a great deal towards giving us a redder fire, and less dead matter on the top of the burning fire. The committee wished to do something better, for still we had complaints; we then raised the chimney-stack 30 yards higher. Even to-day, however, the fumes which come from the top are very heavy, and when the wind is quiet, the lee side of the country suffers from a very disagreeable smell, within a radius of perhaps a mile—the peculiar dry smell of burning wet, dank, vegetable matter. We tried after this a system of blowing. I laid round the whole of a block of ten furnaces, a line of 12-inch pipes, and out of each of these I took a junction of 10 inches into each ash place, and I got the mouth of each ash place bricked up round each junction. Well, of course, when I came to utilise this system I found I had not the necessary power. Although we consumed 50 tons of refuse per day, I found we had not more power than some sixteen or seventeen horse-power—that is, break power outside the engine. I then wrote to the most eminent men in the country who make blowers —who make this a speciality and supply large blowers. I got from three firms estimates of the cost of machinery and blowers sufficient to do the work, with a guarantee that the machinery would be sufficient to produce the necessary blasts in each of the cells. But it came to this, that I really could not undertake it

without 50 horse-power at command. A system of blowing into an enclosed ash place practically requires 5 horse-power per cell. After the pipes had been laid, whilst thinking about this, and talking over the question with the man who had done the work, he said, "What do you think about putting a steam jet under each fire-grate. Rip your machinery out, and take steam actually to the work to be done." I replied, "We will try it." Well, we have attached it to a pair of the cells, in the manner you see in the section before you. A steam pipe is turned into an open pipe which passes into the built-up ash place. We found that, acting in a sense after the manner of an injector, it induces a current of air to press under the fire-bars, which gives me most readily over 1500 degrees of heat. The effect upon the fire of course is much more rapid consumption, and much more flame, due to the admission of hydrogen in the shape of steam. This in fact is what we are doing now. I am in a sense sorry to say that the man who did this for me has been led to devise a combination which he has run away and patented. Although I took care this should not cost Leeds anything, I rather regret it. About six months since I succeeded in stopping a person from patenting something I was then trying. I merely mention this to say that, as an old member of the Association, I do not like the championing of patents. I need not tell you that I have not the ghost of an interest in the one I have been describing. The plans here show what this man's views are. I have told you that with these two steam pipes I get a heat of 1500 degrees. This man proposes to utilise this heat by laying a boiler over the top of the flue running between the two rows of cells, and, through a series of small holes, allow the very highly-heated gases to pass round and about and by tubes through the boiler. When I speak of a jet of steam, I speak of a quarter of an inch jet, and a pressure of anything between 25 and 30 lbs. The committee have ordered me to attach the system to the other furnaces; but, at a meeting which we had the other day, we were not quite sure whether it would not be better to adopt a system of furnaces like those attached to Mr. Jones's crematory. One of the members of the committee, not a scientific man, but a hard-headed Yorkshireman, put a very plain proposition. He said, "I know of course that heat is heat, but that will not do everything. I can understand that heat will make substances break up, and reorganise themselves as different gases, but I can understand that heat might not be a perfect cure, that is would render them inno-

cuous. I cannot help thinking that if these fumes were passed through clean fire they would really come out less harmful than if passed through high heat." Personally I am not chemist sufficient to deal with this aspect of the question. However, as some testimony to Mr. Jones's efforts in this matter, I thought I had better name it. Then as to cost; I may say we have made all sorts of attempts in the way of economy in dealing with our destructors. We have two destructors, so that the carting is not so great as if we only had one. But I cannot get the cost any lower than 10*d.*—that is including every charge for capital and depreciation. I think I have now told you all we have done; as to the future, whether the steam we have at present will be sufficient for the ten cells yet remains to be seen. I think it will, because we know we can now work 15 to 18 horse-power continuously, in the way of making mortar. We certainly ought to be able with double the heat. If we raise the heat up to 1500 degrees through the twenty-four hours, these units of heat are obliged to go somewhere, and if we utilise them by putting them into water, we shall have a better supply of steam in proportion. In answer to Mr. Strachan's question, I should say that, in Leeds, as we are, I am afraid we should not have steam enough for the whole thing without some alteration. Still I am confident it would be a very easy thing indeed to make an arrangement whereby this heat, as I have said before, could be put into the form of steam.

Sir Robert Rawlinson: This question of refuse destruction is so important that I have induced the General Board to permit me to authorise one of the inspectors to undertake the collection of information on this point. I entrusted this to Mr. Codrington, one of the inspectors, whose report has not yet been completed. He has been visiting the various places, and I dare say has come into contact with some of you gentlemen. He is getting together such information as he can obtain on this point.

Note.—*This paper and the discussion was reopened and continued at the Meeting at West Bromwich, the report of which will appear in the next volume.*

AN EXAMINATION OF SOME RECENT EXPERIMENTS ON SEWAGE TREATMENT MADE, BY W. J. DIBDIN, ESQ., F.C.S., F.I.C., FOR THE METROPOLITAN BOARD OF WORKS.

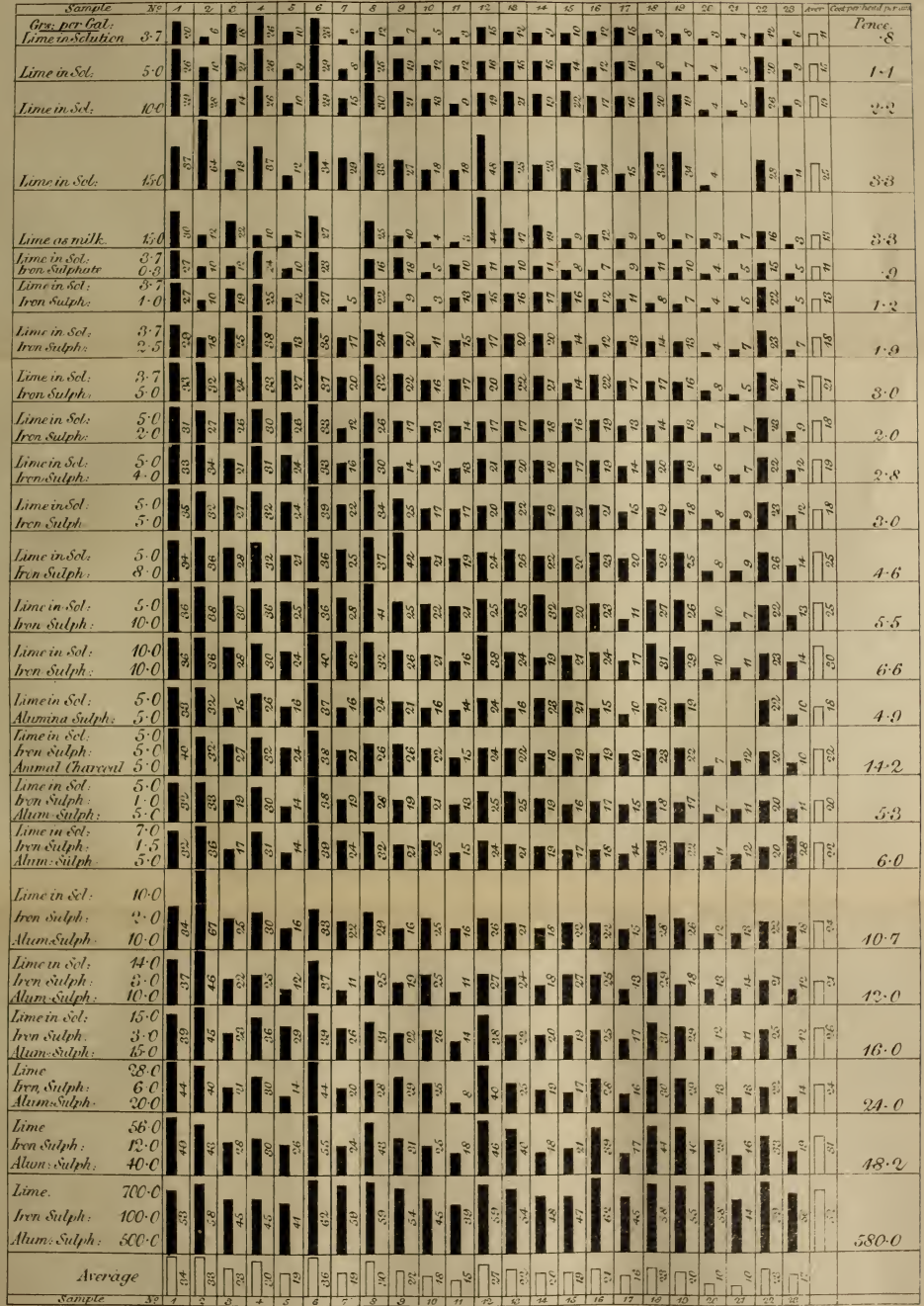
By R. W. Peregrine Birch, M.I.C.E., F.G.S., &c.

Having been honoured by a request from the Council of this Association, the author contributes the following notes upon the subject of sewage precipitation, his object being to encourage investigation by those most competent to make it in the direction he considers most likely to produce useful results. Many Members present are responsible for the treatment of sewage by chemical precipitation, and there are few no doubt who have not tried numerous chemical reagents, or who have not been invited to do so by various patentees, or persons interested in pushing the sale of some particular material. It will be remembered that at the Institution of Civil Engineers at the beginning of the year, an admirable paper was read by Mr. Dibdin, Chemist to the Metropolitan Board of Works, upon sewage sludge and its disposal, in which he sets forth the process about to be put into operation by that Board, for the treatment of the sewage of London. The metropolitan sewage is to be treated with 3·7 grains of lime and 1 grain of sulphate of iron per gallon, and Mr. Dibdin produced the results of a large number of experiments to show that although greater purification might have been effected by a greater expenditure of chemicals the improvement would not have been worth its cost. Great difference of opinion was expressed in the discussion as to the capability of such homœopathic treatment, and it is not proposed here to say anything about the relative merits of different precipitants; but the 500 odd analyses made by Mr. Dibdin besides showing the relative merits of different agents also show the relative susceptibilities of the samples tested, and it is in order to call attention to the importance of this difference that the author has ventured on this occasion to address the Society of

Municipal Engineers and Surveyors. It must be clearly understood that in this communication there is nothing but what could be extracted from Mr. Dibdin's paper; but the object in the two cases not being the same, it has been thought worth while to utilise the large mass of well-authenticated facts obtained by the Metropolitan Board of Works to teach a lesson which on the former occasion was not emphasised as the present author considers it might have been with great advantage. Mr. Dibdin took twenty-three samples of sewage from the Metropolitan Outfall at Crossness, and having extracted from them the matter in suspension, treated each in twenty-five different ways. He used lime alone in quantities varying from 3·7 to 15 grains per gallon, sometimes in solution, sometimes as milk of lime. He used lime in conjunction with sulphate of iron in various proportions, lime together with sulphate of alumina, lime supplemented by both sulphates, and also lime, sulphate of iron and animal charcoal together. As will be seen from the diagram the chemicals necessary for these treatments were estimated to cost from ·81 of a penny per head per annum to 48 shillings per head per annum, and it is obvious from Mr. Dibdin's figures that the use of the larger quantity of chemicals would, independently of the expense of dealing with the increased quantity of sludge, have cost a great deal more than their worth. It is to be learnt from Mr. Dibdin's figures that whether he added 4·7 grains of chemicals or 108 grains to the gallon at costs respectively of 1¼ pence per head and 4 shillings per head, it did not make more than 20 per cent. difference in the amount of organic matter removed. This is very strong if not conclusive evidence in support of the opinion arrived at by the Board of Works, namely, that it was best to limit the amount of chemicals used as proposed by Mr. Dibdin. But although the difference between the effect of one precipitant and another precipitant upon any one of the samples tested is small compared with the cost, the difference in the extent to which two samples have been found to yield the dissolved organic matter contained in them is very striking, and this brings the author to the point he wishes to impress upon the Members of this Association having the management of sewage precipitation works, viz. that more is to be expected from experiment and research into the question of what are the influences affecting the susceptibility of sewage to chemical precipitation than from trials of different chemical agents. The diagram shows what percentage of the dissolved organic matter was removed from each sample

Mr Birch's Paper.

Diagram showing the Percentage Reduction of Oxidizable Organic Matter in Solution by various methods of Chemical Precipitation upon 23 different samples of Sewage.



Mr. Birch's Paper.

Diagram showing the Percentage Reduction of Oxidizable Organic Matter in Solution by various methods of Chemical Precipitation upon 23 different samples of Sewage.

Sample
Nº
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23
Aver.
Cost per head per ann.
Grs. per Gal. Lime in Solution 3·7
Pence. ·8
Lime in Sol. 5·0
1·1
Lime in Sol. 10·0
2·2
Lime in Sol. 15·0
3·3
Lime as milk. 15·0
3·3
Lime in Sol. 3·7 Iron Sulphate 0·3
·9
Lime in Sol. 3·7 Iron Sulph. 1·0
1·2
Lime in Sol. 3·7 Iron Sulph. 2·5
1·9

by every one of the different precipitants. The horizontal rows of ordinates represent the results of one treatment upon twenty-three different samples; the vertical columns the results obtained from treating one sample in twenty-five different ways.

Upon examining the diagram it will be seen that there is a much greater uniformity in the latter set of results than in the former ones, showing that the results arrived at depended more upon some quality or condition of the sewage at the moment of treatment than upon the character or quantity of the precipitant used. For example, compare the behaviour of samples Nos. 1 and 6 with that of Nos. 20 and 21. The two first under the twenty-four different treatments (the twenty-fifth treatment is excepted because of its prohibitory expense) yielded from 20 per cent. and 23 per cent. respectively to 49 and 55 per cent. or an average of 33 per cent. and 35 per cent. respectively, while 20 and 21 only yielded from 0 per cent. to 29 per cent. and 16 per cent., or an average of 8 per cent. and 9 per cent., showing that where the greatest success attended the treatment the result was due more to the sewage than to the precipitant used. It will be seen that certain samples have yielded up their impurities far more generously to *all* of the treatments than other samples have to *any*, and that certain samples yielded more dissolved organic matter to 15 grains of lime than they did even to a greater quantity of lime together with a considerable addition of sulphate of iron and alumina. Columns Nos. 1, 6, and 22 show that a sample of London sewage may be in such a condition that it will yield its dissolved organic matter practically equally well to any of the twenty-five treatments. The few weak places in Columns No. 2 and No. 4, and the one weak place in No. 22 suggest that their occasional stubbornness is due rather to the temporary condition of the sewage when treated than to the class or quantity of filth which they contained, and that the inefficiency of all the reagents alike to touch samples 20 and 21 may be due rather to the conditions under which they were treated than to the elements of which they were composed.

It is obvious when certain samples of sewage yield generously to twenty out of twenty-five different treatments, but in the other cases resist reagents which have been effective with other samples of the same sewage, that the strength of sewage is not the only factor to be considered, and that the variety of result must be due to some varying physical condition, possibly age or temperature, or degree of decomposition of the sewage when treated, or may be to the temperature

of the atmosphere or the barometric or photological conditions prevailing at the time.

The author knows that Mr. Dibdin has not at present satisfied himself as to the meaning of the facts collated on the diagram further than was necessary for the question he had in hand at the time he made the experiments; but the author believes that if the science of sewage precipitation is to be advanced it must be through investigations, by gentlemen in this Association, of the nature and extent of the outside influences which affect the action of precipitating agents upon sewage.

DISCUSSION.

Mr. EACHUS: I will endeavour to follow the good example of the writer of the paper, by making my observations brief and to the point. I have had occasion to have a number of analyses made of sewage effluent water, and I have always found the percentage of results varies inversely with the percentage of oxidisable matter contained in the solution—more than inversely I should say, because the less oxidisable matter you have in solution the less you will be able to precipitate. That is to say, if you have one sample of sewage which is twice as dilute as the other, you will not get half as good results out of the diluted sewage as out of the other. I have found this always in the analyses I have had taken. The main point of the analyses of Mr. Dibdin is, that they go to show it is the chemical constituents of the sewage on which results depend.

Mr. STRACHAN: There is one result of Mr. Dibdin's experiments which we should learn, and that is, "Put not your faith in chemists." The way we are made to alter our works, and to change them back again, because chemists change their minds, is simply disgraceful. What would you say to me if I brought a few picked samples of Guernsey granite from some street, or out of my pocket, as evidence of comparative wear. I find such variations in chemical testing, and the fact is that experiments made with phials and glass beakers are valueless. Dr. Dupré is answerable with Mr. Dibdin for these experiments. He gave very positive evidence at the inquiry which was held in connection with the Thames Valley scheme, that ten hours must be given for precipitation in any chemical process. He was cross-examined upon that point, but he stuck to his guns. Those who

were treating sewage practically said, "We do it every day of our life in three hours." "Nothing of the sort," says Dr. Dupré, "it takes ten hours." What was the result? Why that within a few months he found out his mistake. He then said, "Any one who had had experience of sewage treatment knew that the rate at which precipitants subside varies considerably with the nature of the sewage. The period apparently varied with the bulk treated. Unfortunately he had been experimenting at the time with sewage that required a longer treatment than many others. He had, however, learned, and he now admitted the fact, that the time for precipitation need not be longer than four hours." This was after he had experimented, and had given evidence before the Commission, as a scientific man, that ten hours was absolutely necessary. At the same inquiry he said that 30 grains of chemicals were necessary, and then he goes and advises the Metropolitan Board that 3·7 was sufficient. I think we should set up our backs against being pushed backwards and forwards by chemists. When we have practical experience, we should always bring it to bear when chemists come forward with analyses on which they would build such an enormous undertaking as the disposal of the metropolitan sewage. See how the same sewage varies under the same amount of chemicals. There would not be that variation if a couple of million gallons of sewage were treated at different times, because they would contain all the constituents of ordinary sewage. These laboratory experiments are absolutely valueless when we come to apply them to large problems and to large undertakings.

Sir Robert Rawlinson: I will only say a few words. In dealing with sewage, age is as important an element as anything you have connected with it. If you test sewage one hour after it leaves the sewers, and again twenty-four hours afterwards, or at longer intervals, you will find the character changed, and also the action of the precipitants upon it. But I quite agree with Mr. Strachan, that we must put no faith in chemical analyses when given in evidence to support any measure or any Bill that may be put before any committee or any other body. You gentlemen have the carrying out of the work, you have the great problems to deal with, and you will have to rely in a great degree upon your own judgment and your own experience. I can add to what Mr. Strachan has said, and tell you, if you take upon yourselves to what is termed purify sewage, by any known chemical process,

you must leave the word purify out. Then again, as regards precipitation, whatever action the precipitants may have in throwing down the floating and flocculent matter in sewage, seven-eighths of the salts of sewage still remain. You may clarify sewage until it is as bright as spring water, and yet seven-eighths of the salts which act injuriously when turned out into a watercourse remain in the clarified effluent. Therefore, how the Metropolitan Board is going to purify the Thames by such an imperfect process passes my comprehension. Wherever it has been tried, the effluent water, when it passes into streams, has been found to set up a corrupting process, and in such weather as we have had for the last two months, there are no means of avoiding that. If you are to approach what is termed purification, the sewage must go on to the land. And where you have a sufficient area of land of a proper character—or I might almost say, of an improper character, if you have an area wide enough—it is possible to pass crude sewage on to it without any chemical treatment whatever, and for the land to produce the best possible results from the process. There are now in this country a number of sewage farms, where chemicals do not come near the sewage, which in a crude state passes on to the land, and the land produces good crops. This question of chemical disinfection has cost a great deal of useless money. It has been my fate to be cast into contact with inventors who one after another were going successfully to solve this problem. They have sometimes been sent to me by the Government, and they have come to me of their own accord as well. I have been obliged to listen to their projects and to talk the matter over with them, and sometimes I have thought it right and proper to give them a little advice. But I never succeeded in turning a man from the project he had got into his head; I never succeeded in stopping him from attempting to do what he believed would be a solution of the problem. The consequences have been that they have gone on with their projects, they have expended their money and lost it, but they never believed they were in the wrong. At Coventry a sewage company was established and went on until it had lost 60,000*l.* or 70,000*l.* of the shareholders' money. A second company was then formed, and it was to have a subsidy from the Corporation of 1200*l.* per annum, and all the products of the sewage. They went on for some time, but ultimately failed also. At Coventry they admitted that chemical treatment after it had been done in the best manner, would have failed if they

had not had a portion of very valuable land, over which the clarified sewage could pass before it found its way into the water-course. They had also a very generous landlord in Lord Leigh, who used to work at what was being done rather than find fault with the Corporation. I believe if you clarify sewage, so as to do it in the best possible manner, it will cost you from 2000*l.* per annum per million gallons a day, for which you must reckon you will get nothing in return. At the Leicester sewage works, Mr. Wickstead introduced a system, from which they were to get 30*s.* a ton for the product. They did get that price for a time, but gradually the price came down to 5*s.* per ton, and then, after a time it fetched nothing. When I visited Leicester there were 5000 or 6000 tons of the material piled up on the ground, and ultimately I believe they had to pay people to cart it away, for it was found by experience to have no real value as a manure. I believe the works cost 60,000*l.*

Mr. Fowler: I wish to endorse the remarks of Mr. Strachan, inasmuch as about fifteen years ago the Corporation of Leeds had their faith in chemistry shaken. At that time the "A B C" Company was before the public, and they offered to take the sewage of Leeds and pay a rent for it. The Corporation entered into an agreement with the Company, and constructed works, after 10,000*l.* had been spent on temporary works. The "A B C" Company commenced operations, and they found that the cost of the chemicals necessary was so enormous, that they found it meant ruin to everybody connected with the Company. They therefore applied to the Corporation to be released from their contract, and the Corporation, to get rid of the difficulty, and not wishing to ruin the shareholders of the Company, released them from their agreement. The Corporation then advertised to the whole world, that any chemist or company could have the use of these works, take them into their own hands, treat the sewage as they thought proper, and see whether they could produce a satisfactory effluent water. Messrs. Goodhall, of Leeds, Mr. Anson, and one or two other persons had each possession of the works in this way for a time. They all failed to satisfy the Corporation that the effluent was such as they had stated they should be able to produce, or that the estimate of cost was reliable. This was fifteen years ago, and the result was that the Corporation resorted to the lime process. There is nothing which can be chemically applied to the treatment of sewage which is better than that material. Deputations from the

Manchester Corporation have recently visited many of the large towns, and have come to the conclusion that the Leeds works and the Leeds process are the best. They have therefore adopted the Leeds plan, with the addition that the effluent water will be passed over land for its further purification. I think it has been clearly shown that the data of chemists, from analyses made in glasses of samples of sewage taken at different hours of the day, are fallacious and misleading. We ought to be very careful to read up what has been done in the past before we come to any hasty conclusion. I think Manchester is on the right track, and I think it speaks well for the Leeds Corporation, and for their foresight and care in getting works so carefully prepared, and obtaining results that have been confirmed by the experience of other places. Everybody knows that the Corporation of Manchester are a body of hard-headed, business men, who do not put their money into anything unless they think it perfectly safe. I think we have in them what will be a safer guide than the theoretical conclusions of some chemists.

Mr. H. U. McKie: I agree with Sir Robert Rawlinson respecting the application of sewage to the land, and it was at his suggestion and with the permission of His Grace the Duke of Northumberland that the first experiment was made with fresh raw sewage on a small part of the Home Park grass land at Alnwick. The experiment proved to my mind that sewage could be so applied successfully without any chemical treatment. The application of sewage was not continued, but I took the cue from Sir Robert and tried it at Carlisle. The sewage was put on 60 acres of grass land, which was grazed by cattle almost immediately after the sewage was applied; the cattle never suffered from any disease, but throve well and were soon ready for the fat market. During the seventeen years the sewage was applied to the land, no one complained of a nuisance. I admit the subsoil was very suitable for broad irrigation, it required no drainage, and the levelling and carriers did not cost more than 2*l*. per acre. There was a careful survey made of the land by myself and Mr. James Mansergh, and the whole of the land was contoured every three inches in elevation; from the plan the position of the carriers and the necessary levelling were worked out carefully in the office, and strictly carried out to the line and levels on the ground. The land is not now irrigated, the reason being that the railway companies wanted some of the land, including the site of the engine and pumping station: the engine was 4 or 5 horse-power, driving a centrifugal pump.

In consequence of the railway companies interfering with the irrigation, the lessee, who had a twenty years' lease of the sewage from the Corporation, wanted to have the lease extended, but the Corporation said "No, we know you have been making a profit, and we will carry out the irrigation ourselves." As yet they have done nothing except having plans prepared, but I expect at some future date the sewage will be again applied to the land; the river, however, being near to tidal water, we have no complaints from any one respecting the sewage being put into it. I was engaged three or four months at Tottenham making (under the direction of the late Mr. David Forbes) chemical experiments with phosphate of alumina in tanks which held a considerable quantity of sewage. The result was marvellous; we got a bright clear effluent water in which we could keep fish, and if we had had some land to turn it over, it would have been a perfect way of dealing with sewage. There were, however, some guttapercha works at Tottenham, and when the refuse from them was put into the sewage, it was no use treating it; we could still make the effluent transparent, but it was offensive: with the exception of this, the whole of the experiments were very satisfactory.

Mr. J. Cartwright: I do not go to the length of endorsing all that Mr. Strachan or Mr. Fowler has said. I hold that we have been indebted to chemists in the past, and must to an extent continue to be indebted to them. If we have made wrong deductions from their experiments, the blame should not be put upon them; I have carefully read Mr. Dibdin's paper, and we may take him as an example of the chemists who have investigated this subject. Whatever results may be derived from the paper, it is an interesting one, and if carefully considered may, I think, prove instructive to engineers. The views which Sir Robert Rawlinson has expressed as to the purification of sewage; knowing that he represents "the powers that be," has somewhat disturbed my mind as the surveyor of a Lancashire borough engaged in advising on this subject. In Lancashire the purification of sewage if attempted will largely be by the aid of chemical processes, the situation, nature and cost of land adjoining the towns preclude the hope in all but exceptional cases of obtaining a sufficient quantity of land for the purpose. We must therefore keep our minds bent on chemical treatment, and being dependent on the skill of the chemist, must work in harmony with him.

Mr. A. W. Parry: I wish to say, with reference to the remark

of Sir Robert about applying crude sewage to the land, that out of the area we have at Reading, a person has taken from the Corporation 25 acres, for which he gives us 10*l.* a year per acre. But he takes the sewage just when he wants it, and is not obliged to have it when he does not. Sometimes we are in a difficulty ourselves, and have to dilute our sewage, but that we can do by putting river water into it. At this time we are putting nearly as much water in as there is sewage, for the purpose of benefiting the farm.

Lieut.-Colonel Jones: Mr. Birch in his paper has seized the great points in the table of twenty-three samples, and he has shown the teaching of that table very carefully. There is only one remark I would make, and that is, it has always appeared very astonishing to me, that when chemists wish to compare different samples of sewage they did not let the sewage have a short time to rest, in which it will precipitate itself to a very considerable extent. Then they might try their chemical agents on the liquid, and see what was the effect. It appears to me that, when there are two or three causes which may affect the result, you should eliminate all you can, so that you may more accurately estimate the effect of the remaining causes. The advocates of the different precipitating agents, claim all the effect as the result of the chemicals. They take a turbid liquid, shake it about, and say that the cleaning is effected by the chemicals used, whereas I contend the greater part of that is simply due to stagnation. I agree entirely with what Mr. McKie has said, as to the possibility of purification by irrigation. Irrigation has now stood the test of time. I have been at it for thirty years, more or less, and it is no new thing that has stood this test. If mistakes have been made, they have been in choosing wrong land, spending too large sums in laying it out, or paying too high a rent, but it is still shown that irrigation is the proper system. The thing is to choose the right kind of land, and not make any mistakes in applying the land to it. Mr. Strachan has so exactly expressed my views respecting not trusting to chemists that I will repeat what he has said. I should just like to remark, with regard to the paper by Mr. Dibdin, that the main part of it deals with a deodorising process as well as precipitation. It was deodorisation with a new process, permanganate of potash. It was to revolutionise everything. This permanganate process was devised in order to afford them an excuse for still turning sewage into the Thames; they were directed to keep out

of it. Since Mr. Dibdin's paper was read, qualms have come over the Metropolitan Board, after 400,000*l.* had been spent on bricks and mortar as an instalment of the works at Barking. Well, these qualms have led the Board to decide to consult a chemist not previously employed by the Board. There was a good deal of disposition to fall into Dr. Dupré's arms again, but Sir Henry Roscoe was eventually consulted. I will just read this from the 'Proceedings' of the Metropolitan Board of Works. "The Works Committee submitted a report from Sir Henry Roscoe, stating that the quantity of chloride of lime per gallon of sewage must be increased, therefore the Committee recommended that 2000 tons of chloride of lime should be ordered." Now, you see, it is chloride of lime, whereas it was soda that was to revolutionise everything. "The Deputy Chairman said the Committee found on inquiry that sulphuric acid was not only for deodorising sewage, but also for purifying the Thames. If they had merely kept to the permanganate, it must have been increased in the same ratio. The object was to see whether this would be a cheaper process." Mr. Selway, another member of the Board, said, "It was no part of the duty of the Board to purify the Thames. It was their duty not to put sewage into the Thames to pollute it." I congratulate the Metropolitan Board that, after experimenting with permanganate and chloride of lime, they have come back to the right thing, that it is their duty not to put sewage into the Thames to pollute it. I am not going to advocate my own views, but it is very well known that they have the means, at a reasonable charge on the rates of 1½*d.* in the pound, of removing the whole of the sewage to a piece where it will do good and effectively purify the Thames. Everybody admits it can be done, and yet it is not done.

The PRESIDENT: I may say that we have a great deal of information on this subject at Leicester, but owing to the want of time, and the work that we have before us, I must be bound by my own rule, and refrain from telling you much that I should otherwise have been pleased to have done with regard to this interesting and important question. In one word, I endorse entirely the words which have fallen from Sir Robert Rawlinson, that so far no chemical system—and Leicester has led the way in trying all the chemical systems which have become known—can possibly render sewage innocuous. You may clarify sewage until it is apparently as pure as spring water, and the moment it gets into a river where there is no considerable flow of water, a chemical action takes place

and decomposition follows. At Leicester we are obliged, at the present moment, owing to the very limited rainfall we have had this year, to practically deodorise the whole river in order to obviate the serious complaints we have had from time to time. With reference to the changing views of chemists, I am bound to say that we have really found nothing better as a deodorant than Condy's fluid, permanganate of soda as recommended by Mr. Dibdin, the Metropolitan Board's chemist. It is expensive, but we have no other choice than to adopt this course pending the completion of the sewage farm we have in preparation. We have been driven to irrigation. No chemical system would be applicable to Leicester unless you also had land to pass the effluent water over afterwards. Mr. Fowler must have forgotten Leicester when he referred to the Manchester deputation and the lime process, and said he believed Leeds led the way fifteen years ago. Leicester works were the first where the lime process was adopted in 1854–5, and the phosphate of alumina process to which Mr. McKie had alluded, and various other systems have been tried. At Manchester and Leeds, Mr. Fowler tells you, they have gone back to the lime process pure and simple, but the results will be unsatisfactory unless they have land to pass the effluent water over.

Mr. Fowler: The deputation, I think, visited Leicester twice.

The President: I understood you to mean that the Leeds Corporation, fifteen years ago, were the first to adopt the lime process.

Mr. Fowler: I beg your pardon, if I conveyed that impression I really did not mean it.

Mr. Birch: I am very glad to find, in this large meeting, a strong feeling in favour of treating sewage by applying it to the land, and a feeling of utter disbelief in the efficacy of any chemical treatment. Everybody who knows anything of me knows that I am no friend of chemical treatment or chemical companies. I do not believe there is any kind of land altogether improper for sewage treatment. I quite agree with Mr. Strachan, that we must not put our faith in chemists. I also agree with him that it may be possible to do a thing 500 times in a chemical laboratory, although not in actual practice. But I think we practical men should be neglecting our opportunities if we did not notice what chemists can do at one time with one sample, and what the same men cannot do at another time with another sample. We cannot perhaps build up anything practical on these results alone; but we

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can compare the different results for our advantage. Mr. Eachus has found, and I know it has very often been found, that the stronger the sewage the better it parts with the greater portion of the solid organic matter. But the good results and the bad results in Mr. Dibdin's experiments are not due to the strength of the sample. I cross-examined him very strongly on that, and asked him if he could help me to arrive at the cause? He said he should be glad to help me, but that the more experiments he made the more fogged he was, and he could not say anything definite upon it without more experiments. I hope he will make the experiments and give us the benefit of them. Then Mr. Strachan commented on the discrepancy between Dr. Dupré's views when giving evidence in the Thames Valley inquiry and when advising the Metropolitan Board of Works. We must in justice to Dr. Dupré admit there is a great deal of difference in the situations. I do not believe in the treatment of sewage chemically at Barking, but what might be very useful at Barking might be altogether out of place at Kew, where there is practically no sea water, to increase the volume of inland water which flows down the Thames. I thoroughly agree with what Sir Robert Rawlinson said. Sewage cannot be purified by any means, still less by chemical means. I have never seen any chemical works but what were a great nuisance at certain times.

CREMATION.

By W. EASSIE, C.E., F.L.S., F.G.S., &c.

The disposal of the human body after death has always occupied the earnest attention of the living in all countries, and it may be that the method of simple exposure as against burial was the outcome of much cogitation and dispute among the ancient peoples who practised it. Who can prove that the Phrygians and other races who hung their dead upon the limbs of trees; the North American Indians, who to this day expose their rudely bandaged dead relatives on tall platforms in the prairie; the Syrcanians, who left their dead in the near forests to the wild dogs to devour; the Parsees, who from time immemorial have laid their dead upon gratings on the summit of high "towers of silence" for the vultures, did not adopt these various systems of disposal of the dead after the most profound consideration, apart from any semi-religious or superstitious bias? It was surely easier for these ancient peoples to inter the dead, but the "far off descended ray" apparently taught the very earliest born races to protect themselves from the dead and to consider the earth to be the very property of the living. The practice of the exposure of bodies to the attack of carnivorous birds, beasts of prey, wild dogs, crocodiles, and the like, must have been instituted, not from the want of land for interment or labour to dig graves, but from some inborn consciousness that the earth was required for far nobler purposes than as a storehouse for the putrefying dead.

Some of the aboriginals of Australasia practised burial in the sea, as, for instance, the natives of the Chatham Islands, and this method of disposal finds many advocates at the present day. The late Dr. Parkes, whose colleague the author was in the East in 1855, expressed himself in his well-known work upon Hygiene that burial in the sea *might* suit maritime nations. After all, this is only another form of exposure, and tends to prove that what is sought after is the guardianship of the earth from undue pollution.

Cave-burial was an institution the genesis of which is lost in the far ages. Nevertheless we know that from the time of Abraham

to the time of Christ this was practised by all whose possessions in rocky places enabled them to set aside a roomy site for the purpose. When no such site was available they built underground and other structures, as is seen in Palestine and other places. Many of these ancient burial caves have been discovered just as used by some of the ancient Russian peoples. The Chinese always inter their high-born and imperial rulers in caves up to the present day. This mode of dealing with the dead was preferable to simple interment in the earth, and had a similar motive, namely, the keeping the corpse apart from contact with the soil. As a matter of course, this mode of disposal would be quite out of question in densely populated countries.

Embalming it is almost needless to notice to-night, but it would astonish many that patents are taken out up to the present day for embalming processes intended to be carried out upon the bodies previous to their interment in coffins of wood, lead, glass, and iron.

Desiccation or drying-up of the dead was a world-wide practice from the earliest times, and the system is simply antagonistic to burial and to the contact of the body with the food-producing earth, which never was and never can be suitable to assist in manurial purposes, if only for the fact that the body must be deposited far below the ordinary root-zone of the plants and cereals which mostly furnish food. There is no doubt that the ancient Peruvians, the South Australasians, the Ainos of Japan, and the African races who practise desiccation, either by the heat of fires or from the action of the sun, did so from hygienic considerations.

It may almost be said that when mere exposure of the dead ceased to satisfy, and when cave-burial became obsolete, inhumation or earth burial by contact was introduced with all its inherent drawbacks. Burial in the earth has not existed from the very dawn of our planet's life; certainly no one can absolutely prove this. But it is a very ancient practice, and was the easiest means of hiding the dead out of sight. It matters not how controversialists may decide this point, and it is sufficient to admit that burial in the earth is of remote antiquity. The author does not think that it was resorted to for reasons of health, but for reasons of simplicity, expediency, and economy.

Terrible outbreaks of death-dealing disease have followed indiscriminate and injudicious burial. It would nauseate you to quote

a thousandth part of the number of cases which have been recorded where the depurating power of the earth has been almost *nil.* Earthworms continually, from their very nature, upheave the germ-laden soil from below, with the usual consequences. Some instances need only to be noted where misguided burial has been followed by dire consequences. The author will not mention the reappearance of the plague at Modena, where 600 years before the victims of a plague were interred, and how similar disturbances of the grave-sites caused immediate outbreaks of disease, or enhanced the virulence of epidemics such as cholera and the like. This happened at London in 1854, although the pits had been dug and filled up for almost 200 years. In 1843, when a parish church near Stroud in Gloucestershire was in process of rebuilding, the superfluous soil of the burial-ground was disposed of for manure to the villagers, and the result was nearly a decimation of the place. The outbreak of the plague in Egypt in 1823 was traced to the opening up of a disused burial-ground about 14 miles from Cairo, and thousands perished in consequence.

M. Pasteur states that he has obtained germs of splenic fever as virulent as when the animals died twelve years previously.

A recent investigation was made in the cemeteries of Rio de Janeiro, scarcely four years ago, upon earth taken about spade deep from graves where victims of yellow fever had been buried some twelve months previously, and this soil was found to contain "myriads of microbes," selfsame with those present in persons stricken with the same pest at the time of the excavation. A healthy guinea-pig was incarcerated in a space over which earth taken from a grave was sprinkled, and in five days the animal was dead, its blood being found to be "literally crammed" with the germs of the disease in various stages of evolution. It will therefore be conceded that no argument requires to be sprung in favour of cremation for the relics of humanity when the same thing occurs in respect of the remains of the lower animals.

It is a fortunate thing for us that the majority of the animals which now perish from disease in our crowded towns are no longer buried in the earth, but are scientifically destroyed, and even some valuable products recovered. But this was not so in the olden times, when the corpses were merely thrown into a hole in the neighbourhood of the cattle markets. It is almost impossible to excavate any distance in Shepherds' Market, now Mayfair, London, without coming across numberless relics of animals

slaughtered from motives of health for their own race, but interred to the detriment of their owners.

The author does not think cremation will ever become universal, and he is equally satisfied that burial in the earth never was a universal practice. Since the abandonment by gradually civilised and growing nations of disposal of the dead by exposure, desiccation, embalming, and the like, burial in the earth followed, and as the ancient world was opened up to the new, the practice of cremation in the former was brought to the knowledge of newer races, and eventually enthusiastically taken up by the Greeks and Romans. And both burial and cremation were practised at the option of the relatives, and this accommodation of parties must always continue to rule. Socrates was made to say that he had no care whether he was buried or burnt, but this apathy was rarely exhibited, and soon the rite of cremation was exalted to such an extent that certain of the citizens were forbidden it. All suicides, all persons killed by lightning, and all the still-born were excluded from the pyre.

When the star of Christianity climbed the horizon, it became necessary for its teachers to adopt some distinction between Christians and Pagans, and very evidently the Christian leaders decided upon discarding cremation, and insisting upon the practice of inhumation. A wide-spread schism followed, and the rupture became perfect, when the system of burial in and around the churches began to obtain with the community. This practice of crowding the churches and churchyards with the dead was carried to such an extent, that about 1843 the burials in London around the churches averaged in some cases 1204 per acre, in others 1278 per acre, in several 1560 per acre, in one case 2323 per acre. This was surely burial around the churches with a vengeance!

In ten years following 1852, when Orders in Council were issued to stay this monstrous evil, some 4000 old burial grounds were closed, and the good work of regulating interments is still carried on. Within the same space of time some 400 local Burial Boards were constituted, and this number has been far enhanced. Then necessarily followed the institution of cemeteries, and the Metropolis alone has now one acre of burial ground for every 1000 inhabitants, although, of course, this is partly taken up by roads and shrubberies. At present London has 22 cemeteries, with an aggregate of 2210 acres.

A cemetery should have a close dry and yet porous soil, such as

would allow the rain, and the air which accompanies it, to pass down to the level of the lowest interment. With a soil like this the depth for burial might be extended to a dozen feet, and everything save the larger bones would disappear in a dozen years. When a cemetery soil is very dense and clayey, it is impervious to moisture and therefore objectionable. Its drawbacks can be partially redeemed by deep cross drains with gravelled bottoms and by pipe drains being laid between the bottom of each grave-space. The spaces nearest the deep drains should be first used, gravelled at the bottom, and each subsequent grave, after being gravelled at the foot, should be connected with the other graves, and all drain into the cross drains, the outfall of which should be carefully chosen. Graves in clay formations are sometimes improved by the admixture of gravel and sand when refilling the graves. The cost of these proceedings is however very great, and it cannot be said that any commensurate success ever attended it. The author has been informed that the cemetery instituted by the Corporation of this city is formed of a stiff and almost impervious clay, and that a tenth of a million of dead have been laid in it. It is hoped that matters are not so unencouraging as this, however.

Just as wheat may be said to be the ultimatum of all grasses, cremation will be the final and the chiefly chosen improvement upon burial. Where the earth is suitable for due resolution of the body nothing can perhaps be preferable, but most unfortunately this consummation cannot be always achieved, and even where a suitable soil can be obtained, there are dangers of air pollution and fouling of water, which have always to be strenuously guarded against, as many a community knows.

Since the resuscitation of the practice of cremation, brought about in our country by the telling works of Sir Henry Thompson, several ideas have been introduced to public notice with a view of minimising the dangers known to be attendant upon any promiscuous system of interment. The author will only notice one, and that is what has been called earth-to-earth interment, and the use of wicker baskets in lieu of coffins. No improvement can be seen here upon what was prevalent with our forefathers, when no coffin was used at all. Winding sheets alone were in use until the 16th century, and in the Vestry Minutes of St. Helens, Bishopsgate, London, there occurs under the date of March 5th, 1564, an order that no one shall be buried within the church unless the corpse be confined in wood. Up to the present time, many old families in Ireland inter their

dead with shrouds only. At the conclusion of a paper which the author read at York in September last, before one of the learned Societies, the Dean of York mentioned incidentally that at Easingwold, close by, there was a parish coffin, which had been in existence for several hundred years, whereby bodies were conveyed to the grave, and there consigned without inclosure to the earth.

It is sickening to read, as the author has done in the Records of the Patent Office, the various improvements which have been laid before the public from 1781 to even last year; sickening to any one who has formed a high estimate of his fellow man. Fancy plans for all kinds of coffins in stone, marble, granite, slate, cement, porcelain, earthenware, bitumen, asphalte, papier maché, peat, indiarubber, iron, and glass being foisted upon us! An inclosure in lead was the parent of all these strivings after a long preservation of the dead, and this is now becoming altogether condemned, seeing that it robs the earth of its very own. The wicker-basket inclosure is no innovation, and should have a fair field, but its application must be very limited; and it is impossible to see how a body which has perished from, for instance, bad confluent smallpox, could be laid in the earth without detriment. The author opines that all who have perished from contagious disease, and all the unclaimed dead, should be compulsorily reduced to ashes at the nearest crematory. And in order that such conveniences should exist, the author would feel inclined to recommend that for the future, at all events, every new or enlarged cemetery should be compelled to erect a crematory of some economical kind on its grounds, to carry out such cremations, as also to afford optional cremation to those desiring it—those who desire when dead to leave their mother earth not worse than they found her.

Cremation is variously practised now, but in former times the funeral pyre was most resorted to. The burning ghauts of India give an example of this at the present day. At the present moment the reform wave of cremation has reached even the Mauritius, and failing a proper crematory, the people preferring cremation are having recourse to the common pyre. In some parts of Japan the body is seated, and after the body has been surrounded by the wood the orifice is closed, and the body is reduced to ashes. In January of this year an exactly similar cremation took place in Russia, when the remains of the Lama or Grand Priest of the Calmucks was consumed.

To describe even a fiftieth of the various methods of cremation which the author has in his possession would weary you.

The systems of cremation now in use may be said to consist of the Gorini, the Venini, and the Siemens methods. There are others, but it would serve no purpose to explain them to you. The author has seen the various systems in use at various places abroad, and chose for use by the Cremation Society of England, which is a learned and not a trading society, the Gorini system, and the author was instructed to erect one at their grounds, St. John's, Woking, Surrey, which he did. As yet no temple or chapel surrounds the crematory, but that can only be a question of time.

The procedure in the Gorini system may be shortly stated to be as follows:—A fire is first lighted in the chimney close to its base, and through this all smoke and evolved gases are destroyed, thus precluding the escape of any deleterious products which may have escaped from the first combustion in the crematory chamber. A fire is then lighted in the furnace portion of the crematory, and this is chiefly composed of wood faggots, with a sprinkling of anthracite coals, and the heat from this passes through flues under and above the crematory chamber, where the body is placed. When the reception chamber has been sufficiently heated, the body is introduced, and is consumed in little over an hour, the residuum being pure white ashes. The tray is withdrawn after the chamber has somewhat cooled down, and the ashes reverently deposited in a suitable receptacle. On the Siemens system, the requisite amount of destructive heat is first of all generated by combusted fuel, the flame from which imparts most of its heat to the fire-brick or regenerator chamber, and when the apparatus has been in operation sufficiently long, this fire-brick and crematory chamber become of the usual white heat. The tray containing the body is then slid along the rollers, into the crematory chamber, atmospheric air is laid on, and when the ashes have fallen into the receptacle below they are inurned.

The progress of cremation within the last few years has been very rapid, and there now exist scientifically constructed crematories at Woking, England; at Gotha, Germany; at Milan, Lodi, Cremona, Varese, Udine, Padua, Brescia, and Rome in Italy; at Geneva, Switzerland; and at New York, Buffalo, and other places in America. France is also completing an extensive establishment in Paris; and other countries, such as Holland,

Belgium, and Sweden, only await a recognition of the right to perform cremation when it is sought for.

The license will come in good time to those who work and wait, as we did in England, until it was manifest that there was no legal bar to the reformed practice. About twenty-five cremations have taken place in England, the last of them being that of a retainer of Maharaj Sir Pertab Singh, of Judhpore, India, who himself, with a suite, attended to witness the ceremony, and who removed the ashes afterwards for immersion in water, as he explained to me, according to Hindoo custom.

The cost of cremation varies, according to the number cremated with one heating of the crematory. But it varies from 6*l.* to 2*l.*, the former sum ruling in England, where succeeding cremations have not as yet occurred. As to the custody of the ashes, they have chiefly hitherto in England been removed by the relatives, and interred in churchyards or vaults. But the desirable practice would be to collect them for a given time in a columbarium attached to the crematory, and after twenty years, if not claimed then, disposed of upon the ground. There seems to be a consensus of opinion in favour of this, because no good could accrue from the preservation of ashes when none of the family care to pay a fee for further conservation. Many persons simply specify that the ashes shall be strewn upon the earth.

Very much nonsense has been spoken and written upon the possible effects resulting from the destruction of bodies by fire, and the asserted loss of ammonia resulting therefrom was but one of the many bogus objections. With an audience such as this the author would not venture upon the religious objections made, because they do not merit a moment's attention and are puerile to a degree. There is also a series of sentimental exceptions taken to cremation, but they none of them rise even to the level of merest platitudes.

The Cremation Society of England, of which the author has been both Hon. Secretary and Hon. Engineer from its commencement, was formed to promote the objects set forth in the following declaration:—

"We disapprove the present custom of burying the dead, and desire to substitute some mode which shall rapidly resolve the body into its component elements by a process which cannot offend the living, and shall render the remains absolutely innocuous. Until some better method is devised, we desire to adopt that usually known as cremation."

The conditions of membership are:—

I. Adhesion by signature to the above declaration.

II. The payment of an annual subscription of one guinea, or a single payment of ten guineas.

III. The payment of ten guineas, with an obligation from the Society ensuring cremation after death.

Much has been said concerning the possibility of cremation becoming an inducement to commit crime by means of poison. But with the safeguards now taken by the committees where cremation is carried out no concealment is possible. People seem to forget that for one body presented for cremation in possibly five thousand there could be no possible mistake as to the cause of death.

The securities demanded by the English Society are as follows:—

(*a*) An application in writing must be made by the friends or executors of the deceased—unless it has been made by the deceased person himself during life—stating that it was the wish of the deceased to be cremated after death.

(*b*) Two certificates from duly qualified medical men are required relative to the cause of death, one, at least, of whom must have attended the deceased.

These must satisfy the Council of the Society or their representative, and in some rare or doubtful case an autopsy might be desirable. Several autopsies have already been made by orders of the friends of the deceased themselves previous to cremation.

A branch of the Cremation Society of England has been formed in Leicester by some very influential citizens, and will be certain to prosper. The author ought to say that he has not come to Leicester to carry out any propaganda here in order to induce any one to join in the movement, nor was he asked to do so, or been in communication hereon with any one member of the Leicester Cremation Society. He is simply a guest of the Association of Municipal Engineers, who are holding their Congress in your beautiful city.

In conclusion, the author has tried to lay a few matters before the meeting for consideration and discussion, and the short time he has had to prepare them bids him to ask for your forbearance where shortcomings are palpable.

DISCUSSION.

The PRESIDENT: I think we are very greatly indebted to the reader of this paper. It will follow very appropriately the kindred subject of the cremation of town refuse. The subject is one, no doubt, on which a great many persons outside this Association would desire to have something to say.

Mr. BOULNOIS: I rise to avow myself in favour of the cremation of dead bodies. I do so, sir, on sentimental as well as on sanitary grounds. Time will not permit us to go very far into this question; but perhaps Mr. Eassie will tell us, when he replies, the amount of ashes left from an ordinary body of say 10 st. weight. For many years I have noticed all the horrors connected with earth burials, and also the want of rest which people get by putting the bodies of their friends in the earth. They think they are placing them where they will rest until the resurrection; but the fact is it very seldom does occur that they do rest where they are placed. Bodies have frequently to be removed for town improvements, and we know one instance where a peaceful village churchyard has had to be disturbed. In the Vyrnwy valley, the village churchyard has had to be removed, because it would be at the bottom of the lake which will supply Liverpool with water. One objection to cremation, I think, is that persons interested in burials will lose their fees. If it were made clear to the undertaker, and even to the clergyman, that their fees will not be disturbed, I think a great deal of the opposition would cease.

Mr. A. M. FOWLER: there is no doubt that graveyards are a great detriment to the health of the people. At Hinderwell, a town I am now supplying with water, the inhabitants derive their supply from the graveyard, and it was said that this water was pure because it passed through the lime in the bones of the persons burned. I know, too, that the drainage from the Burmantofts Cemetery at Leeds went into a brook from one side. That brook was an open stream, consequently there must have been a liability to its being taken by children, and perhaps by other people. These are only two such instances which have come under my own notice, but probably there are thousands of others. Therefore on sanitary grounds it is highly essential that some better means than burial according to the present system should be adopted for disposing of the dead. I am exceedingly obliged personally to Mr. Eassie for his very interesting paper.

Mr. Hodson: I declare myself in favour of cremation, and believe it to be the system of the future. The thanks of this Association and of the country are due to Mr. Eassie for the persistency with which he has brought this subject forward. Mr. Eassie is a very old sanitarian. Many years ago he published his book 'Healthy Houses,' which has remained a text-book until this day. In that work he advocates the necessity of laying drains surrounded by concrete—the disconnection of all soil pipes and of the house drains from the main sewers. Many people did not believe in him then, but a great many of the ideas he recommended twenty years ago, and published to the world, have now been unanimously adopted and approved. In this matter of cremation, I look upon him as twenty years in advance of this generation. It will take twenty years to familiarise the people with the idea of cremation. In addition to the fees to which Mr. Boulnois has referred, another, and as I believe a very serious difficulty is, that people consider cremation is an unchristian practice. It is not the way in which they have been accustomed to dispose of their dead, and they think nothing of the danger to the living by adhering to the system they have been used to for many generations. I wish to supplement the remarks of Mr. Fowler as to the danger from some burial grounds. In South Staffordshire some years ago I distinctly remember a burial ground that stood on rising ground. The dip of the strata was towards houses on the lower level, and the people got their water from surface wells. They did not use it for drinking purposes, but they thought it good enough for washing their house floors. I have actually seen the water so used form a lather on the house floors. This, you will admit, was not likely to put the houses in a sanitary condition, although it might wash them down. At Loughborough we have another difficulty. Drains have been laid down in the cemetery; but people plant willows and trees there, and the roots strike down into these deep drains. I have seen them 10 feet deep, and I have taken out willow roots 10 and 11 yards long, which have thus found their way into the drains. The consequence was that the drains were stopped up, and matters got to such a pitch at last that the Burial Board asked me to devise some means of curing the evil. There were the usual brick graves and vaults, and as the drains got stopped, the graves became flooded. When a funeral was to take place, the gravediggers kept on the look out, and when they saw the cortège approaching, the grave was quickly baled out. The

last bucketful was often got out as the funeral was entering the graveyard, sawdust was then sprinkled on the floor, and the coffin was got in as soon as possible. As soon as the mourners got away the grave was filled in quickly, because of the flooding. This has been remedied for a time, but the same thing will happen again, when the roots of the willows have got down into the drains. This is simply an illustration of some of the errors of the old system of burial. When cremation becomes popular, we shall have a rational system of dealing with the dead. On all sanitary grounds it is desirable that it should be adopted, and on sentimental grounds also. There is no reason why the idea of a religious service could not be carried out in a temple adjoining a crematory, just as well as in a cemetery chapel, and with just as much reverence and decency. I hope Mr. Eassie will persist in his efforts until this very necessary reform is carried out.

Mr. E. B. Ellice-Clark: I should like to reply to the observation which has unfortunately fallen from Mr. Boulnois, as to the clergy not being in favour of cremation because of the danger of their losing their fees. The Church of England Funeral Reform Association, of the council of which I happen to be a member, has frequently discussed this question, and the reason they have not adopted cremation as a means of disposing of the dead, I do not think is the selfish one attributed to them by Mr. Boulnois. It is perhaps travelling into a religious question, but the burial service of the Church of England directs that the body shall be buried; and the scruples of the clergy—especially the Bishop of Gloucester, who has taken a deep interest in this matter—are not due to any selfish motives, because their fees will probably remain. The Church of England says distinctly that the body shall be buried, and until the law is altered, as it doubtless will be in time, in my humble judgment, you will not make much advance with cremation. Discussions of this kind are exceedingly useful, because it is only by hammering away at a subject like this that you can hope to revolutionise public opinion. When in the course of time you have familiarised the people with this idea, a great and strong effort will be made by members of the Church of England to have the option of being cremated instead of being buried.

Dr. Tomkins (Medical Officer of Health, Leicester): I take it that you are more interested with the manner in which cremation should be carried out, and not in any discussion as to the necessity of it being adopted. Most sanitarians are convinced of the neces-

sity of something being done, and more interesting points are how cremation can be carried out in an unobjectionable, economical, and sanitary manner. Many of the members of this Association will doubtless have had in their official capacity opportunities of observing the objectionable and offensive results of the present system of earth burial. We have had this question before our Corporation, and the President will tell you he has already drawn plans for a crematory in this town. I do not think, however, that the question has made much progress with the public. Medical men and scientific men generally favour cremation on sanitary grounds, but public opinion has yet to be influenced.

Mr. HEWSON: Did I rightly understand Mr. Eassie to say that harm could arise to animals grazing in a cemetery where people had been buried who had died from certain infectious diseases. If that is so, it seems to me we ought at once to have the medical officers of health of England dealing with this subject. There are in many churchyards certain parts of the graveyards set apart specially for the reception of bodies which have died from cholera and other infectious diseases. If I understood Mr. Eassie aright, the grass which grows on such graves should be destroyed. With respect to cremation, I think myself it is the correct thing; but I feel more comfortable in regard to it when I remember it will not come into vogue until after my time.

The PRESIDENT: I notice Mr. Eassie refers to a branch of the Cremation Society of England having been formed in Leicester. I would just like to say that the paper read this morning is undoubtedly of great interest to a considerable section of the public in Leicester. It may be interesting to this meeting to know—I speak under correction, of course—that the Corporation of Leicester is the first municipal body which has gone so far as to consider the subject of cremation, on a memorial presented to them on behalf of the local Cremation Association. The Corporation appointed a committee to consider the question, and at their request I prepared plans for a complete crematory at Leicester. Those plans you see on the wall behind me, and I also prepared an estimate of the cost. The plans embrace a complete establishment, and provide, what Mr. Eassie incidentally referred to, for a large number of urns in a columbaria. In fact, the principle is taken from the crematory at Milan. The difficulty likely to influence municipal bodies is the financial one, and that led to its rejection here for the present. The matter went so far, however, that a vote of the council was

taken on the subject, when, whilst thirteen voted for it, there was a large majority against the adoption of the report presented by the cremation committee. Probably the vote was not directly on the question of whether cremation was the right thing or not, but as to the difficulty of obtaining money to erect a crematory to meet the wishes of the memorialists. Mr. Eassie will perhaps correct me if I am wrong in saying that Leicester Corporation is the first that has gone so far in the matter. The question, therefore, may be said to be making some progress, but I express no opinion myself further than that, though I admit it is undoubtedly the correct thing in principle, and that it is the best mode of disposing of the dead, yet I am afraid that I am personally in the same position as some other persons present—that I have not yet got over the sentiment which is necessarily involved in the proposed change in the mode of disposing of the dead. The author of this paper is the greatest living authority on this question. He knows exactly what has been done in every country, and is familiar with the whole subject. After inquiring into the various methods of cremating the dead, and inspecting the various crematories, Mr. Eassie has come to the conclusion that the Gorini system is the best. Doubtless those interested in this question will take nearly all Mr. Eassie says on this subject for granted. I believe myself, as Mr. Hodson has said, that those who are in favour of cremation are in advance of the times. I am sure this Association will heartily accord its thanks to Mr. Eassie for the very valuable information he has given us in the interesting paper he has read to us this morning.

Mr. W. Eassie: The first question asked was as to the weight of the ashes from an ordinary body when cremated. A body of 20 stones should be reduced to less than 6½ lb. An average person would come down to about 4 lb. I have had the ashes weighed after the last twenty cremations, and they rarely exceeded 6 lb.; in one instance they weighed 7 lb., but that was from a large body. As to the cost of cremation, the Society makes a charge, but does not seek to make a profit. The cost at present is 6*l*., but if three or four cremations followed each other the cost could be reduced to 30*s*. or 2*l*. With reference to the religious service of the Church of England the Dean of York told us, if the people of England were determined to have cremation, the Church of England would have to follow suit. The Leicester Cremation Society is the very first established in

England, and therefore it stands very high in our opinion. I believe the time will come, and in a very short time indeed now, when they will be able to carry the idea out. Nothing could be more charming than the plans Mr. Gordon has produced. The crematory accommodation provided is quite sufficient for a town of this size. Mr. Hewson asked a question whether, supposing any dead bodies were buried containing microbes or germs of disease, whether they could be imported into the growing crop. The bodies generally are buried so far below the reach of the roots of the crops, that they would not be likely to be affected. But Baron Seebach mentions a case where a sheep which died from splenic fever was buried in the corner of one of his fields, which next year was covered with clover. One day his attention was directed to the luxuriance of this clover, and a few days later he noticed that some one had cut it and stolen it. A few days later a poor peasant-woman came to implore his assistance, as a goat she had had died, and her cow was ill. On examination it was found that the disease with which they were affected was splenic fever, and the woman then confessed that she had stolen the clover from the corner of the field where the sheep was buried. He is the Saxon minister at Paris, and he tells you these facts. I think at large cemeteries the authorities should be compelled to put up a crematory, if only for the purpose of getting rid of the bodies of persons who die from confluent smallpox, cholera, and other infectious diseases. The world, I am sure, teems with the history of these microbes, and therefore it is almost ridiculous to say anything more about it.

JENNINGS AND BREWER'S PATENT ELECTRO MECHANICAL APPARATUS FOR INDICATING AND REGISTERING VARYING LEVELS OF LIQUIDS IN RESERVOIRS, SEWERS AND ELSEWHERE, AND WHICH IS ALSO APPLICABLE FOR DENOTING THE DIRECTION AND VELOCITY OF AIR CURRENTS.

By WALTER JENNINGS, of the firm of George Jennings, Electrical and Sanitary Engineers, Stangate, London.

Although the author has much pleasure in availing himself of the opportunity of bringing the subject of this invention before a practically interested audience, he regrets having cause to apologise for the but meagre particulars he is only able to furnish in consequence of the limited period which has elapsed since the perfecting of the apparatus now before the meeting, and which he will now endeavour to briefly describe.

The object of the invention is to register correctly the fluctuations in level of water or sewage at any distance from the point of observation, as for instance in reservoirs some miles outside towns, or outfall sewers in low-lying portions of districts liable to flooding. In such cases the apparatus will be found of considerable use and in many instances invaluable, as it indicates truly what is taking place in the reservoir or sewer, and automatically records the result in indelible ink on the diagram attached to the revolving drum.

He asks the meeting to accept the cylinder as representing the sewer or reservoir the level of liquid in which it is desired to record.

Within the cylinder is a float, the dead weight of which is counterpoised by means of a weight suspended from a chain passing over a pulley of certain dimensions.

The chain supplies the motive power to the transmitter, which

is a clockwork movement automatically and mechanically registering the rise or fall of the float and transmitting same by electric means to the receiver.

The escapement action of this receiver is a principal and characteristic feature of the invention, and worthy, the author thinks, of special notice, the ratchet wheels while at rest being immovable and held in position by both pawls, the action of which renders any "tripping" or error in registration impossible.

Another advantage is that the ratchet wheels do not directly derive their motive power from the electric current, which simply actuates the brake, at the same time preparing the pawls for action. The current then being broken by the transmitter and the brake released, the falling pawls again lock the ratchet wheel after revolving it one section.

Apparatus heretofore devised for these and similar purposes have been attended with but partial success consequent on the use of "tumbler" contacts in the transmitter, the instantaneous and uncertain action of which renders the results unreliable and inapplicable to fine adjustments. Furthermore, the reversed movement of the mechanism due to indication of varying levels has been found objectionable as tending to complication, but hitherto inseparable from such arrangements.

It should also be mentioned that the receiver can be controlled by a separate and independent "relay" placed at any distance from it.

The following is a general description of the apparatus, taken from the 'Builder,' Sept. 17th, 1887:—The illustration (Fig. 1) shows the apparatus working in connection with a reservoir in which is a cylinder and containing the float A. The float is connected to a chain passing over the pulley B, the dead weight of the float being counterpoised by a weight attached to the other end of the chain. The pulley B is keyed to the shaft C, which sets in motion the mechanism of the transmitter D, and at every inch or other period or difference of level (as may be arranged) of rise or fall, an electric current is transmitted along the line E to the indicator or receiver F, which may be situated at any distance from the reservoir and is usually fixed in the engine-room at the pumping station. A recording arrangement, G, can be added, so that a permanent record can be kept of the varying levels during each week on a diagram attached to the revolving drum, which contains a clockwork movement.

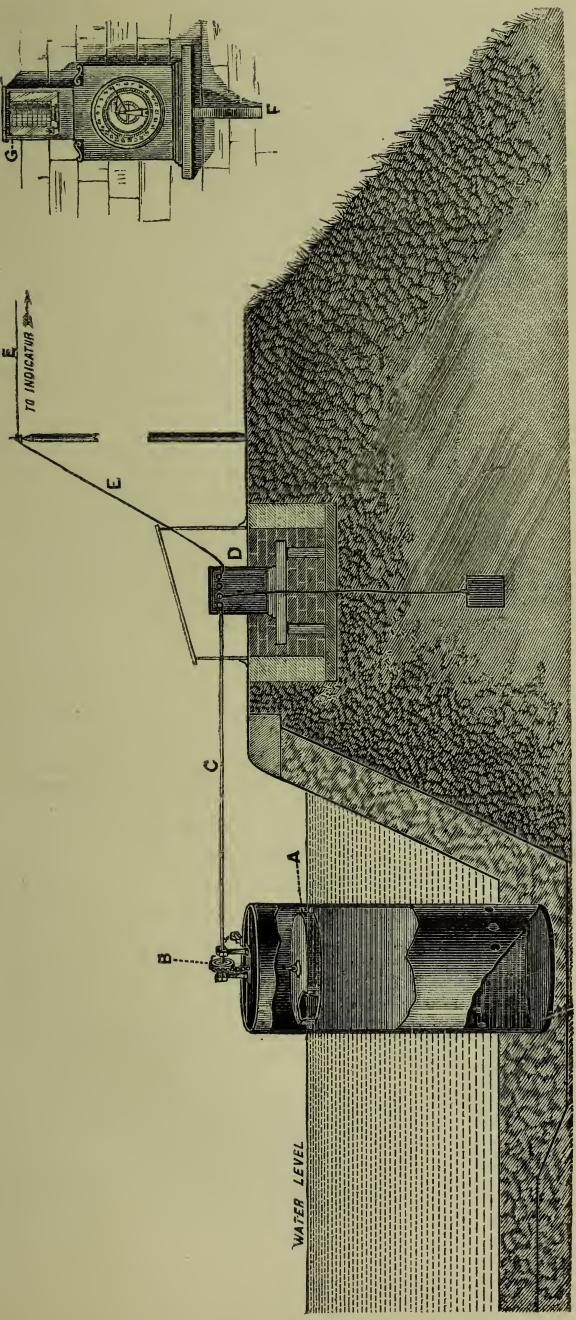

FIG. 1.

Fig. 2 shows the arrangement of the transmitter (marked D in Fig. 1). The weight G, when raised by the movement of the

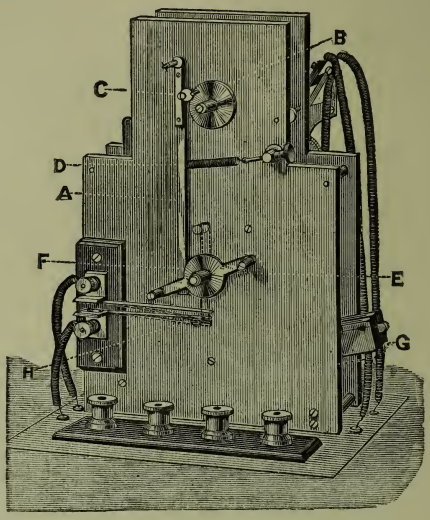

Fig. 2.

float, is held in position by a clutch on the lever A catching against a pin on the double revolving arm E. The weight G is released by the lever A when thrust out by a pin on the revolving disc B striking against the adjustable cam on the lever A at C, thereby causing the double arm E to revolve one half turn, when it is again caught and retained by a similar arrangement on the obverse side of the transmitter, so that at every period of rise or fall of the liquid in the reservoir the lever A, being alternately acted upon by the disc B, first releases and subsequently holds in position the revolving arm E. The latter, in revolving, presses together the two springs H for an appreciable space of time, thus completing an electric circuit.

Fig. 3 is a kind of isometrical bird's-eye viewof the back of the transmitter, showing the commutator and the spindle to which is attached the shaft on which the pulley B rotates.

Fig. 4 shows the mechanism of the indicator or receiver when at rest.

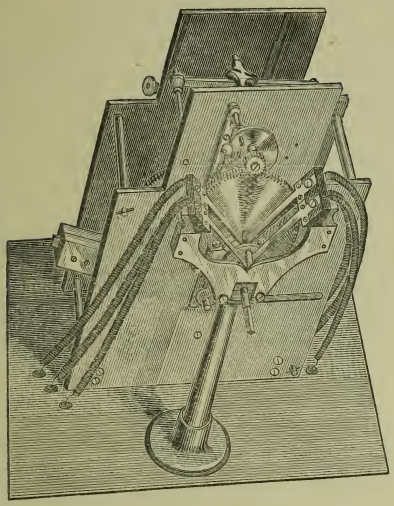

FIG. 3.

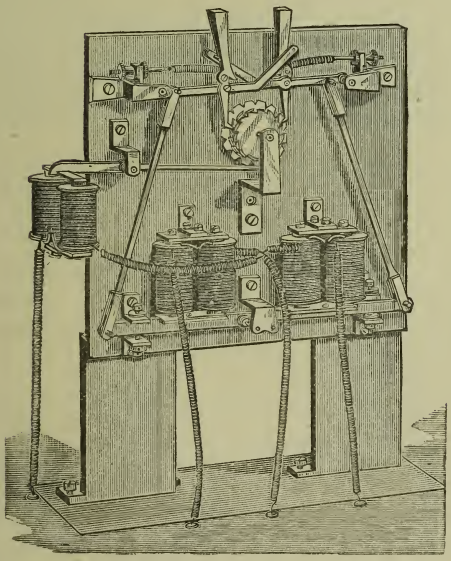

FIG. 4.

Fig. 5 shows the upper part of the same mechanism when an electric current from the transmitter is received, — the rods H H having been elevated by the action of the electro-magnets, thereby lifting the levers G G, to which are pivoted the pawls one tooth higher of the wheel A; at the same time a pin at the end of the lever G draws out the opposite pawl clear of the wheel A, and the current, passing through the coils J, attracts the armature on the end of the lever E, the reverse end of which is pointed at D to fit into the notched break wheel B. Upon the current being broken the break is instantly released, and the pawl that has been raised, upon falling, engages a tooth and causes the wheels to revolve one section of the circumference and allows the

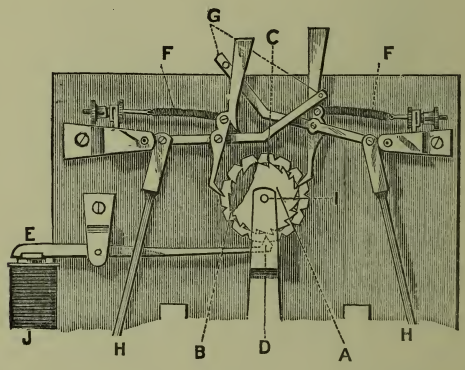

Fig. 5.

opposite pawl to resume its former position, thus immovably fixing the escapement wheels A, which are fixed with the teeth opposite, thus providing a similar action to take place when the current is reversed by the commutator.

The inventors claim that the apparatus is also applicable for denoting the direction and velocity of air currents. Into this phase of the invention we need not here enter, but we may mention that when the apparatus was exhibited and described at the meeting before referred to, the general opinion of the borough surveyors and engineers then assembled was that the apparatus is likely to prove of great practical and public utility, especially in indicating the level of water in sewers.

DISCUSSION.

Mr. Boulnois: In case a sewage tank was suddenly emptied, would the float dropping down in that way interfere with the action of the instrument—say a quick drop of 15 feet?

Mr. Jennings: I may safely say the sudden emptying of a tank would not interfere with the action. It would go on registering accurately still.

Mr. Lemon: What distance can you fix it away from the works?

Mr. Jennings: The apparatus may be fixed any reasonable distance—twenty miles or more.

Mr. Hewson: I should like to know whether you would object to explaining clearly what the mechanical action is? For instance, in taking the level of the water as it varies, do you succeed in registering it by means of reducing or enlarging the potential of electricity, or by a mechanical arrangement making and breaking contact with the current?

Mr. Jennings: In answer to Mr. Hewson—the rise and fall of the float in the reservoir actuates the transmitter, which transmits each rise and fall in the reservoir to the registering apparatus, although the action of the transmitter always moves one way, by a mechanical arrangement in the transmitter. So far as the question of period is concerned, we have a means of recording $\frac{1}{2}$-inch falls or rises.

The President: I would just say that this appears to me to be a very valuable instrument. I have no doubt Mr. Jennings had more particularly in his mind the registering of the rise and fall of distant reservoirs when he studied this subject. But I would also point out to Mr. Jennings how very valuable this instrument would be if it could be simplified and be made applicable to tanks generally. No doubt many of you have the same difficulty that I have with our sewers in Leicester, from their becoming overcharged. When the rainfall is sudden and excessive, the sewers become gorged, and they back into the cellars in the lower parts of the town. We have had claims from the owners of such flooded cellars against the Corporation, sometimes of a heavy character. Now I have had for some years a self-registering rain gauge by which we know at any ten minutes of the twenty-four hours, precisely the intensity of the rainfall that has been the cause of the flooding. This has enabled me to show, to the law

courts, when claims for damages have been made, that it would be impossible to provide sewers capable of taking a rainfall equal to 2 inches an hour. If Mr. Jennings could simplify his apparatus, and it could be adapted to registering in manholes the height to which the water has risen in our sewers, we should have precise data to calculate the effect of rainfalls in the gorging of our sewers. I especially direct his attention to this subject, and hope that he will find the means of providing us with a cheaper instrument, which we can apply in the way I have indicated.

Mr. JENNINGS: I wish to thank Mr. Gordon most heartily for his very valuable hint. I may say the matter which he has suggested has already had our very serious consideration. The next step we shall take with this instrument will be with a view of cheapening its production, and also of adapting it for the purpose Mr. Gordon has named—that of registering the rise and fall of water in sewers. There is no doubt a very large field for its use in connection with waterworks, but I think there will be a still larger field in connection with sewers. There has always been considerable difficulty in arriving at the result as to what extent the sewers are charged in consequence of a heavy rainfall. Up to the present time the instruments devised for the purpose have been very imperfect and have not been reliable; but I flatter myself that our instrument can be safely relied upon, and that it will accurately record the rise and fall in inches, or as I have already said, if required in half inches. I have been asked the cost of this apparatus. The invention is only in its infancy, and therefore I can hardly state what would be the actual cost of the apparatus. When produced in large numbers the cost would no doubt be considerably reduced. However, from a sort of estimate I have formed in my own mind, I think the cost would be about 50*l.* for the set of instruments. I cannot say any exact price, because it may vary one way or the other according to the number manufactured.

On Thursday visits were paid to the Old Town Hall; the Roman Pavement; the Public Baths, Bath Lane; the Co-operative Society's Boot and Shoe Manufactory, Dun's Lane; Mr. Fielding Johnson's Spinning Factory, East Bond Street; and Mr. Raven's Hosiery Factory, Wheat Street, Wharf Street. In the evening the Members dined together at the Masonic Hall, Halford Street: among the visitors were Sir Robert Rawlinson, C.B.; Alderman J. Hart, J.P., Mayor of Leicester; Major

Tulloch, R.E.; Alderman Kempson, J.P., and Chambers, J.P.; Dr. Tomkins, Medical Officer of Health for the Borough; Mr. R. W. P. Birch, &c.

On Friday the Members visited the New Weir and Flood Basins, Freemen's Meadow, where they were photographed in a group. They then proceeded to the Aylestone Road Gasworks, where they were shown the recently completed Chemical Works, Mr. Colson, the Gas Engineer and Manager, explaining the various processes; the New Gas Tanks in progress, were afterwards inspected. Visits were next paid to the New Sewerage Works, Belgrave Road; the Abbey Park; and to the Open-Air Swimming Bath at St. Margaret's Pasture. In the evening the Members were very hospitably received by the Mayor and Mayoress at a garden fête at their residence, Ashleigh, Knighton.

On Saturday the Members proceeded in brakes to the Victoria Stone Company's Works at Groby, where they were received by Mr. Griffiths, the lessee. A visit was then paid to the Bradgate Reservoir and Pumping Station, where Alderman Barfoot, Chairman of the Committee, met the party. A move was then made through Rothley to Mount Sorrel, where by appointment the visitors were met by Mr. R. F. Martin. Two heavy blasts were fired here, and after the whole process adopted at the quarries had been demonstrated, an adjournment was made to the hall for luncheon, kindly provided by the Company. A visit was next paid to the Barrow Hydraulic Lime Works. For the purpose of visiting these, an engine was provided by the Mount Sorrel Company, and carriages were placed at their disposal by the Midland Railway Company. Reaching the Works, the Members were met by Mr. Wilfred Ellis, who undertook the duty of guide. The blue lias lime beds were first examined, and then the party made a tour of the underground workings which had been specially lighted up for their convenience. The New Cement Works were next visited, and the process of making the cement was fully illustrated. A return by rail was then made to Mount Sorrel, and thence the party returned to Leicester viâ the Abbey Park.

APPENDIX.

STATISTICS RELATING TO THE KEEP OF HORSES.

By JOHN T. EAYRS, Assoc. M. Inst. C.E.,
Borough Surveyor, West Bromwich.

These statistics have been obtained from various local authorities in consequence of some difference of opinion as to the food and bedding provided for the horses belonging to this Corporation.

The subject of the keep of horses is a very interesting one, and a perusal of the tabulated returns shows the various methods of feeding adopted by local authorities, while the variation in the amount of food given in different towns is very remarkable. One can quite understand that horses working in a level town require less food than in hilly towns, but such a difference as 120 lb. of dry food in one town and 341 lb. in another can hardly be explained.

The interest taken in the subject is evinced by my receiving applications for copies of the return from all parts, and I have to thank those gentlemen who so kindly favoured me with replies to my inquiries, at the same time I wish to say that the return would have been much more complete if many surveyors had not failed to send me their information.

Do you insure Horses against accidents?	Do you allow for deterioration in value of Horses, if so, at what rate?	Average rate per day for the hire of horse, cart, and man in your Town.	REMARKS
No.	No.	8/-	
No.	10%	7/-	
Fire.	10%	8/-	We find it much cheaper to keep our own Horses.
No.	No.	8/6	
No.	14%	8/-	Moss Litter costs twice as much as Sawdust. £200 per annum taken for actual Veterinary work.
No.	5%	9/-	
Fire.	5%	7/-	
No.	No.	8/-	Horses valued every year.
Fire.	..	10/-	
No.	£5 per hrs. per anm.	8/-	
No.	No.	10/-	
No.	No.	7/-	
No.	..	7/6	
No.	10%	8/-	
No.	No.	7/-	Provender Committee buy Provender, and regulate supplies given to Horses.
No.	7½%	8/-	
No.	£100 per annm.	8/-	
No.	No.	8/-	
No.	10%	8/6	
No.	No.	7/-	

NAME.	No. of Horses kept.	What quantity of Food is allowed per Horse per week?									Do you give your Horses Green-meat, if so, what quantities?				On what are they bedded, and what quantity is allowed per week?			If you have tried Moss Litter, state how long you have used it, and whether you approve of it.	Do you find any difficulty in disposing of the Manure?	What is the total cost for keep and bedding per Horse per week?	Do you employ a Veterinary Surgeon?			Average cost of Veterinary charges per Horse per annum.	Do you insure Horses against accidents?	Do you allow for deterioration in value of Horses, if so, at what rate?	Average rate per day for the hire of horse, cart, and man in your Town.	REMARKS
		Beans.	Oats.	Bran.	Maize.	Peas.	Hay or Clover.	Straw in Chaff.		Weight of Dry Food.	Clover.	Vetches.	Carrots.		Straw.	Moss Litter.	Sawdust.				Contract.	Agreement.	Salary.					
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.											
Aston Manor	16	35	21	..	56	..	84	..	..	196	..	..	..	..	21	..	..	..	No.	12/-	..	Yes.	..	8/-	No.	No.	8/-	
Bacup	5	30	30	60	30	..	140	..	..	290	Turned out to grass 9 weeks in summer.				28	..	..	..	No.	16/-	..	Yes.	..	20/-	No.	10%	7/-	
Barrow	12	26	19½	17	..	..	108	..	29 Bean Meal	200	..	Yes.	..	Turnips.	42	..	..	..	No.	12/3	6/6	..	..	..	Fire.	10%	8/-	We find it much cheaper to keep our own Horses.
Beckenham	8	..	100	5	..	8½	126	42	..	281	Small bundle.	..	..	..	Yes.	..	..	..	No. 3/6 per ld.	17/-	Yes. £1	..	..	£1	No.	No.	8/6	
Birmingham	265	28	28	4	77	14	98	..	..	249	28 1 month.		..	..	..	..	5 Bushels per week.	Yes. 3 mos., no ill effects.	No.	11/6¼	..	..	£400	15/-	No.	14%	8/-	Moss Litter costs twice as much as Sawdust. £200 per annum taken for actual Veterinary work.
Blackburn	58	25	50	30	20	15	98	..	..	238	..	..	..	..	42	..	..	..	No.	13/6	As required.			3/2	No.	5%	9/-	
Blackpool	18	..	..	13	50	17	124	..	1 Linseed.	205	..	..	Very few, 2 cwt. per annum.	..	42	..	..	..	No.	12/4	Ordinary charges.			2/9	Fire.	5%	7/-	
Bolton	50	18	63	36	18	..	ad lib.	..	..	..	Given under directions of Veterinary Surgeon.				42	..	..	..	No.	14/6	14/-	..	..	14/-	No.	No.	8/-	Horses valued every year.
Bournemouth ..	23	33	80	11	..	..	168	..	..	292	Yes.	Yes.	..	..	70	..	..	..	No.	17/4	..	..	£21	£21	Fire.	..	10/-	
Bradford	68	No reliable record.								..	..	..	6 12 wks.	..	42 Winter.	25 Summer.	..	3 Years. summer season.	No.	13/2½	Horse Keeper experienced and undertakes the work.				No.	£5 per hrs. per ann.	8/-	
Brentford	7	..	176	8	..	..	152	..	..	336½	..	..	..	Ryegrs	56	..	..	..	No.	15/6	21/- per annum.			..	No.	No.	10/-	
Bridgewater	6	..	38	28	30	..	112	..	..	208	Yes.	..	..	..	112	..	..	..	No.	12/-	Ordinary charges.			£1	No.	No.	7/-	
Bristol	13	..	76	28	..	..	168	..	..	272	No.				..	..	Bushels. 5	..	No.	..	As required.			..	No.	..	7/6	
Burnley	5	40	..	40	..	..	..	..	40 Sharps.	120	..	..	..	..	Yes.	..	..	..	4/- per ton	17/-	Ordinary charges.			..	No.	10%	8/-	
Burton-on-Trent ..	44	31½	31½	21	..	..	168	..	..	252	80 For about 18 weeks.				50	..	..	..	No.	16/-	Fees.			50/-	No.	No.	7/-	Provender Committee buy Provender, and regulate supplies given to Horses.
Cardiff	21	40	40	28	40	..	130	..	..	278	..	..	..	..	56	..	..	No. Strongly objected to.	No.	15/-	Yes.	..	..	..	No.	7½%	8/-	
Chester	1	21	1¾ measures.	33	..	..	112	..	..	..	No.				56	..	..	..	No.	..	10/6	..	..	10/6	No.	£100 per annm.	8/-	
Chorley	15	12	33	35	8	12	200	..	..	300	30 3 months.	30	10 3 mths.	..	180	..	..	..	No.	16/-	£1	..	..	..	No.	No.	8/-	
Coventry	12	70	84	14	..	..	105	70	..	343	Very seldom.				21	..	..	..	No.	16/4	Ordinary charges.			£1	No.	10%	8/6	
Darlington	13	..	105	7	10½	28	84	..	..	234½	..	..	7 14 weeks.	28 Rye grass 14 weeks.	70	..	..	Yes. No. A few wks	8/6 per ton. No.	18/-	As required.			..	No.	No.	7/-	

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		Beans.	Oats.	Bran.	Maize.	Peas.	Hay or Clover.	Straw in Chaff.		Weight of Dry Food.	Clover.	Vetches.	Carrots.		Straw.	Moss Litter.	Sawdust.				Contract.	Agreement.	Salary.					
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.											
Derby	50	31½	66½	35	..	..	83	..	..	216	205		4	..	ad lib.	..	..	..	No.	13/8¼	As required.			4/9½	No.	10%	8/-	
											17 weeks.																	
Doncaster	6	35	35	28	..	..	ad lib.	..	..	..	Turned out to grass at nights in summer months.				ad lib.	..	..	..	No.	..	As required.			..	No.	..	8/-	
Enfield	6	..	114	..	..	..	140	..	..	254	ad lib., 12 weeks.				140	..	..	..	No.	14/-	As required.			£2	No.	£50 per annum	8/-	
Folkestone	8	48	76	28	..	..	..	..	112 Sanfoin.	264	No.				28	..	..	..	£60 per year by contract.	15/-	..	..	..	..	No.	No.	9/-	
Glasgow	180	26	42	12	54	..	98	..	12 Barley.	244	No.				42	..	56	Yes, a year or two in loose bxs.	No.	12/5 less manure sold.	10/-	..	..	10/-	No.	Valued annually.	9/-	A cooked mash given daily, except during the hottest summer months.
Gloucester	12	49	21	35	49	..	56	56	..	266	..	ad lib.	..	..	ad lib.	..	..	..	No. 3/6 per ton	18/-	31/6	..	..	31/6	No.	No.	7/-	Stable Committee buy Corn and Horses, and regulate food. The system is not recommended.
Gravesend	10	11	76	17	..	..	168	..	..	272	48 23 wks.	..	..	..	36	..	..	..	No.	10/10½	..	..	..	..	No.	No.	8/-	
Handsworth	6	35	70	42	..	..	ad lib.		..	..	No.				ad lib.	..	..	Yes, during summer months.	No.	14/5	30/-	..	..	30/-	No.	..	8/3	Committee do not consider Moss Litter warm enough for winter bedding.
Hanley	9	80	..	50	..	..	ad lib.		..	..	ad lib.	..	..		ad lib.	..	..	..	No.	14/3	£1	..	..	£1	No.	No.	7/6	
Hartlepool	..	84 lbs. return not definite.					182	..	..	..	7/- per horse per wk for 6 wks				70	..	..	..	No.	18/-including shoeing.	As required.			10/-	No.	No.	8/-	
Hastings	34	..	114	6½	..	37	84	10	..	251	6 weeks.				56	..	..	..	No.	..	Ordinary charges.			27/-	..	No.	8/-	
Heckmondwike ..	4	..	49	49	21	21	ad lib.	..	..	..	Turned out in summer.				ad lib.	..	..	..	No.	..	..	..	..	..	No.	No.	8/-	
Hereford	9	..	84	25	..	..	56	56	..	221	..	Varies, 6 wks.		..	56	..	..	..	No.	17/6	Ordinary charges.			22/3	No.	£50 per annum.	7/3	
Huddersfield	40	..	64	56	64	..	ad lib.		..	..	14 2 months.	..	..		ad lib.	..	..	..	No.	14/7½	£1	..	..	£1	No.	Yes, after 10 yrs. old	7/6	
Ipswich	27	..	87	6	..	..	149	..	..	242	..	..	..	24 Beet. 30 weeks.	112	..	..	No. Yes.	No.	13/7	Ordinary charges.			5/7	No.	Annual allowance.	8/-	
Kidderminster ..	7	40	43	75	..	..	70		..	228	..	..	..	50 Rye grs. 12 wks	..	60	..	6 months Yes. Vet. pref. straw	No.	..	£10 per annum.			28/7	No.	No.	9/-	
Kingston	8	..	120	..	..	..	168	..	..	288	..	..	..	24 Rye grs. 24 wks	36	..	..	..	No.	..	Ordinary charges.			..	No.	No.	8/-	
Lancaster	8	..	50	30	35	..	ad lib.	..	..	..	..	..	..	5 Turnips 8 weeks.	2 Bottles	..	..	Yes. No.	No.	13/2	Ordinary charges.			8/6	No.	10%	8/6	Every alternate week Pea Meal instead of Split Maize. Horses turned out in summer at night on aftermath.
Leicester	98	10½	35	28	56	10½	84		2 Linseed Cake.	226	56 18 weeks.		4 20 wks.	..	ad lib.	..	..	6 months in loose boxes, Yes	No.	13/9¼	..	..	£150 including C. D. Act.	13/6	No.	..	1/- per hr.	
Lincoln	15	..	70	25	..	..	175	..	5½ Linseed Cake.	275	Yes, July to Sept.	..	7 Nov to Ap	..	54	..	..	..	No.	14/6	Ordinary charges.			£1	No.	No.	8/-	Shoeing, harness repairs, vet. surg. and misc. cost 2/7½ for 1886.
Liverpool	277	27	4	20¾	76¼	..	79	..	..	207	14 lbs. for whole year.				51½	..	..	For loose boxes.	No.	11/2	..	..	Yes.	..	No.	No.	9/-	
Longton	8	45	45 or Maize	50	..	..	140	..	..	280	Turned out to grass for 5 mths				35	..	..	..	No.	14/3	..	..	£12	30/-	No.	..	7/6	

ge of ri- es e n.	Do you insure Horses against accidents?	Do you allow for deteriora-tion in value of Horses, if so, at what rate.	Average rate per day for the hire of horse, cart, and man in your Town.	REMARKS.
-	No.	Working life of hrs. taken at 10 years.	9/-	
-	No.	No.	9/-	
	Yes.	..	10/-	
	No.	Yearly valuation.	8/-	
	No.	No.	7/6	
	No.	No.	7/-	
	No.	No.	7/-	
	No.	10%	9/-	
/-	No.	No.	6/6	
4	No.	No.	9/-	Contractor removes manure and allows 4d. per horse per week for it.
/-	No.	10%	8/-	
2	No.	10%	9/-	1 Pint of Boiled Linseed is given.
/-	Yes.	Yes.	8/-	
2	Fire.	5%	10/-	Goode's Desiccated Food tried but found unsatisfac-tory.
3	No.	10%	9/-	
-	No.	Valued annually.	6/6	The cost per week includes shoeing, repairs to harness, buildings, vet. surgeon's fees, &c., last year 19/.
-	No.	..	8/9	
	No.	£4 per ann'm	7/-	Shoeing 1s. 2d. per week.
	No.	..	8/-	
3	No.	10% on orignl cost	8/-	
/-	No.	..	8/-	
-	Yes.	1 0	8/-	

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		Beans.	Oats.	Bran.	Maize.	Peas.	Hay or Clover.	Straw in Chaff.		Weight of Dry Food.	Clover.	Vetches.	Carrots.		Straw.	Moss Litter.	Sawdust.				Contract.	Agreement.	Salary.					
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.											
Maidstone	9	16	80	42	..	..	140	..	..	278	80 13 wks.	..	..	..	72	..	..	..	No. 3/- per load.	15/6	Ordinary charges.			20/-	No.	Working life of hrs. taken at 10 years.	9/-	
Manchester	280	26	42	30	56	..	98	..	..	252	..	..	70 Swedes		35	..	..	Yes. No.	No.	12/9 less value of manure.	12/-	..	..	12/-	No.	No.	9/-	
Middlesbrough ..	16	ad lib.		..	..	..	ad lib.	..	..	..	ad lib. 13 wks.	..	..	..	ad lib.	..	..	..	No.	£1	Ordinary charges.			£1	Yes.	..	10/-	
Newcastle-on-Tyne	70	36	28⅘	2½	89⅐	..	64	..	..	220	14 6 wks.	..	..	14 Turnips 6 weeks.	63	..	..	..	..	12/11	..	..	£150	..	No.	Yearly valuation.	8/-	
Northampton ..	16	86	40	7	..	..	84	..	..	217	..	..	..	20 Italian Rye grass 12 weeks.	84	..	..	..	No.	16/6	£1	..	..	£1	No.	No.	7/6	
Norwich	28	..	72½	38	..	35	142	..	..	287	..	Yes. 4 mths	..	6 Beet, 6 mth	Yes.	..	..	Yes. No.	No.	17/- to 19/	£4 including shoeing.	..	..	..	No.	No.	7/-	
Oxford	9	23	80	..	..	..	140	50	..	293	..	..	..	..	10	..	..	..	No.	17/6	Ordinary charges.			£1	No.	No.	7/-	
Pendleton	30	..	56	41	30	..	67	22	1 Linseed.	217	14 3 wks.	..	Seldom	..	40	..	..	..	No.	14/-	20/-	..	..	£1	No.	10%	9/-	
Peterborough ..	8	33	100	..	..	..	100	..	..	233	80 Rye grs. 15 wks	..	..	24 mangolds, 15 weeks.	100	..	..	..	No.	15/-	Ordinary charges.			15/-	No.	No.	6/6	
Portsmouth	66	22	84	25½	..	..	98	98	..	327½	..	Yes. 13 wks.	..	..	49	..	..	..	No.	15/-	..	..	£37/10	11/4	No.	No.	9/-	Contractor removes manure and allows 4d. per horse per week for it.
Preston	33	No record kept.									No record kept.				ad lib.	..	..	Yes. 14 dys. No.	No.	15/-	18/-	..	..	18/-	No.	10%	8/-	
Ramsgate	9	24	70	49	..	..	..	193 sanfoin		336	..	..	..	18 Sanfoin 10 weeks.	62	..	..	..	No.	17/-	£2	..	..	£2	No.	10%	9/-	1 Pint of Boiled Linseed is given.
Reading	15	33	80	30	..	..	168	..	..	311	..	..	..	Rye grass 13 weeks.	54	..	..	..	No.	17/-	15/-	..	..	15/-	Yes.	Yes.	8/-	
Richmond	22	13	152	17 Winter only.	..	..	112	..	..	294	24 17 wks.	..	..	..	36	..	..	..	No. 5/- per wk	16/6	.. Per annum.	Yes. Ordinary charges for doctoring.	£20	66/2	Fire.	5%	10/-	Goode's Desiccated Food tried but found unsatisfactory.
Rochdale	11	14	28	42	14	..	126	..	..	224	20 12 weeks		10 9 wks.	..	34	..	..	No.	No. 4/6 per ton	15/-	Ordinary charges.			6/3	No.	10%	9/-	
Rotherham	10	..	84	56	..	..	130	..	..	270	56 12 to 15 wks	..	..	..	43	..	..	..	No. 4/9 per ton	21/4	15/-	..	..	15/-	No.	Valued annually.	6/6	The cost per week includes shoeing, repairs to harness, buildings, vet. surgeon's fees, &c., last year 19/.
Salford	7	..	63	31½	31½	..	ad lib.	..	..	..	20 8 weeks		6 13 wks.	..	4¼ Battens	..	..	..	No.	13/-	26/-	..	..	26/-	No.	..	8/9	
Scarborough	26	..	98	35	..	..	126	..	..	259	42 18 wks.	..	..	..	56	..	..	..	No.	14/2½	..	..	..	£1	No.	£4 per ann'm	7/-	Shoeing 1s. 2d. per week.
St. Albans	6	35	73	19	..	..	84	..	..	211	..	..	..	6 mangolds wks	36	..	..	..	No.	18/-	As required.			£3	No.	..	8/-	
Sheffield	104	98 lbs. Beans, Oats, and Maize.					ad lib.	..	..	..	14 8 wks.	..	..	..	ad lib.	ad lib.	..	18 mth Yes.	No.	12/8	Ordinary charges.			21/6	No.	10% on origni cost	8/-	
Shrewsbury	13	21	18	22	..	..	224	..	..	285	140 12 weeks	..	..	..	56	..	..	..	No.	..	25/-	..	..	25/-	No.	..	8/-	
Southport	16	20	63	30	..	..	44	..	..	157	No record of quantity.				50	..	..	..	No.	10/-	15/-	..	..	15/-	Yes.	1 0	8/-	

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		Beans.	Oats.	Bran.	Maize.	Peas.	Hay or Clover.	Straw in Chaff.		Weight of Dry Food.	Clover.	Vetches.	Carrots.		Straw.	Moss Litter.	Sawdust.				Contract.	Agreement.	Salary.					
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.											
South Shields ..	27	28	56	14	28	..	84	..	..	210	..	..	4	..	..	56	..	4 years	No.	14/7	£1	..	..	£1	Fire.	No.	8/-	
Stafford	5	..	49	70	49	..	84	84	..	336	..	2 Bundles 11 weeks.	6 wks.	..	ad lib.	..	..	Yes. ..	No.	18/-	Ordinary charges.			£3	No.	104/- per ann'm.	7/-	
Stockton	9	7½	75	9	..	..	138	..	..	229½	9 weeks		..	..	56	..	..	..	No.	12/2½	As required. Attendance Fee 2/6.			..	No.	..	8/-	
Sunderland	50	14	56	28	14	14	91	..	..	217	4 wks.	..	If sick	..	..	Yes.	..	5 years.	No.	13/-	15/-	..	..	15/-	No.	£5 per ann'm.	7/6	
Tipton	10	24½	..	47½	24½	..	217	..	..	313½	..	..	..	Grass few weeks in summer.	49	..	..	vry. much ..	No.	14/8	When required.			9/- about	No.	..	8/-	
Torquay	17	27¼	80¾	7	..	..	197½	..	..	312½	..	..	..	..	17¾	..	..	..	No. 6d. per horse per week.	14/-	Ordinary charges.			11/-	No.	No.	8/-	
Walsall	23	14	14	42	70	14	98 Chaff		..	252	ad lib.		..	..	..	28	..	short time Yes.	No.	14/9	Ordinary charges.			38/6	No.	..	8/-	
Wallasey	6	56	40	22	..	..	125	..	..	243	..	20 6 wks.	..	..	80	..	..	..	No. 5/6 per ton	16/-	..	7/6 per vst incl. linaments, &c.	..	£1 consid-er'd beavy	No.	£30 per ann'm.	7/6	
Warrington	13	40	60	30	..	..	..	..	5 Oatmeal.	135	2 cwt. for 8 weeks		..	..	Yes.	..	..	..	No.	16/2	£1	..	..	£1	..	..	8/-	
Wednesbury	5	24	24	56	24	..	168	45	..	341	Turned out between June and September		..	5 Swedes Dec. to Ap	50	..	..	..	No.	15/4	..	..	..	Practically nil.	..	15%	10/-	
West Derby	12	20	..	10	80	..	59	..	..	169	..	..	..	11 Grass 26 weeks.	56	..	..	..	No.	12/2	£4/10 incl. sharp'ing & shoeing	..	..	£5	No.	..	8/-	
West Hartlepool ..	7	..	105	7	..	..	72	..	7 Linseed.	191	ad lib. 13 wks. 6/5 per week.	..	..	..	134	..	..	..	No. 2/6 per ld.	14/6	Ordinary charges.			30/-	No.	10%	7/-	Cost per week per Horse for keep, repairs to harness, carts, &c., 19/-, ditto including rent of stables, depreciation &c., 21s. 2½d.
Wigan	28	17	..	15	64	..	91	..	..	187	..	Small quantity in Season.	5 all year round.	..	160	..	..	..	No.	13/-	Ordinary charges.			13/-	No.	..	8/-	
Winchester	8	33	100	..	..	..	..	..	112 Sanfoin.	245	..	..	..	..	ad lib.	..	..	..	No.	15/-	..	..	£25 per an incl. mrkt. at'ndance	..	No.	..	8/-	
Withington	8	..	84	42	21	..	70	..	..	217	..	..	..	Comfrey smr. mths	42	..	..	..	No.	12/6	Ordinary charges.			14/-	No.	..	8/9	
Wolverhampton ..	42	56	..	63	56	..	154	..	..	329	None.			..	..	49½	33	Yes very recently.	No.	13/-	10/-	..	..	10/-	No.	No.	7/- to 7/6	
Woolwich	12	14 6 mths.	180	14	..	..	96	..	..	304	..	..	..	..	56	..	..	..	No.	17/4	19/-	..	..	£1	No.	No.	7/9	
York	24	25	140	23	..	..	112	..	..	300	18 8 wks.	..	7 5 mths.	..	54	..	..	..	No. 5/- per ld.	14/-	Ordinary charges.			15/-	Yes.	..	7/-	
West Bromwich ..	17	50	30	56	..	..	112	56	..	304	92		4	..	..	56	..	7 mths.	No. 2/6 per ton.	14/5	£1	..	£1	£1	Fire.	..	7/6	
„ (New System)	17	28	40	30	28	..	98	10	..	234	10 weeks 28 12 weeks		6 wks. 4 12 wks.	..	..	56	..	..	..	12/3	18/	..	..	18/	Fire.	..	..	When green-meat is used a reduction of 14 lbs. of Maize and 28 lbs. of Hay is to be made.

VOLUNTARY EXAMINATIONS.

SYLLABUS.

The Association of Municipal and Sanitary Engineers and Surveyors have undertaken the holding of Voluntary Pass Examinations for Candidates for Surveyorships under Municipal Corporations and the Local Government Acts.

There will be two Examinations in each year, one in April, in London, and one in October, in some provincial town to be fixed on by the Council, and advertised in the "Builder" six months beforehand.

The Examinations will be by written papers, and *viva voce* upon the four following subjects :—

1st. Engineering as applied to Municipal work.
2nd. Building Construction and Materials.
3rd. Sanitary Science as applied to Towns and Buildings.
4th. Public Health Acts, and Rivers Pollution Acts.

Examples of the class of questions proposed to be asked under these heads are appended hereto.

Candidates will be allowed two hours to answer the questions under each of the four heads, and will not necessarily be required to answer all the questions set in each paper, though not less than four must be taken: marks will be given for all questions properly answered. The *viva voce* examination will be held after the written papers have all been sent in, and will be directed to the further elucidation of the answers to the papers on each subject, and to such practical points as fairly arise therefrom.

The Examinations will extend over one or two days, as circumstances may require, and in the latter case the arrangements will be, as far as possible, as follows:—

First day	..	10	to 12	..	Engineering.
„	..	2	„ 4	..	Building Construction.
„	..	5	„ 7	..	Sanitary Science.
Second day	..	9.30	„ 11.30		Public Health Law.
„	..	1	„ 4	..	*Viva voce* Examination.

The total number of marks required to constitute a pass will be 50 per cent. in each of the subjects.

Each candidate has to fill a Form of Application, to be obtained from the Secretary.

The fee for each Examination will be 3*l.* 3*s.*, one guinea to be paid on application, and the balance on the day of examination. Should the candidate fail, he will be entitled to present himself again at the next, or any subsequent Examination, on payment of one-half of the above fee.

No further charge will be made to the candidate than the fees above mentioned.

Candidates that do not present themselves for the Examination forfeit the entrance fee.

Successful candidates will be entitled to receive a Certificate in the form of a "Testamur," signed by the Examiners for the time being, and countersigned by the President and Secretary of the Association in Council.

Further details and particulars may be obtained on application to Mr. Thos. Cole, Secretary to the Association, 6, Westminster Chambers, Victoria Street, S.W.

SUBJECTS OF EXAMINATION.

I.—Engineering as applied to Municipal Work:

A. Land Surveying and Levelling.
B. Hydraulics.
C. Drainage and Sewerage.
D. Water Supply.
E. Road Making.

II.—Building Construction: Strength of Materials:

A. Materials.
B. The Construction of Public and Private Buildings.
C. Building Bye-laws.

III.—Sanitary Science as applied to Towns and Buildings:

A. Ventilation.
B. Sewage Disposal.
C. House Drainage.

IV.—Public Health Acts.
Rivers Pollution Acts.

SECOND EXAMINATION.

The Second Examination of Candidates was held at the St. George's Hall, Liverpool, on Friday and Saturday the 1st and 2nd of October, 1886, at which the following Examination Papers were set to the candidates.

Subject:—Engineering as Applied to Municipal Work.

Examiner.—W. Geo. Laws, M. Inst. C.E., City Engineer, Newcastle-on-Tyne.

1. Explain the mode of effecting a Triangulation, and show how from one measured base line all the main lines of a Survey are calculated.
2. Describe the "Dumpy Level," and how it is set up for use. Give a specimen of a "Level Book," showing "Back," "Fore," and "Intermediate" sights, and the mode of getting the "Reduced Levels."
3. In taking accurate levels over a series of stakes, how would you work to neutralize errors of "curvature" and "collimation," and why?
4. Explain the terms "Hydrostatic Pressure," "Head," "Hydraulic Gradient." What will be the pressure per square foot on a vertical dam, at 12 feet below the surface of a fresh-water Reservoir?
5. Describe the usual modes of flushing Sewers, self-acting or otherwise; and give your reasons for or against each.
6. In laying out a system of sewers, what are the chief points to aim at as to "lines," "inclinations," "depths," and "sizes" of the pipes? Where should manholes be placed, and why?
7. In a town built on a slope, how would you prevent the sewer gas from the lower levels rising to the higher? Sketch a ventilating manhole, with any arrangement you would propose for this purpose.
8. Describe the systems of roadmaking of McAdam and Telford. Specify shortly for a first-class road on the latter system.
9. Give a cross section of a 40-feet paved street for ordinary town traffic, showing the "Paving and Bottoming," "Kerbing," "Flagging," &c., with the dimensions you would adopt.
10. What are the relative advantages and disadvantages of:—
    - *a.* Granite Sett Paving,
    - *b.* Wood Paving,
    - *c.* Macadam Roads, as regards first cost, maintenance, scavenging, and convenience?
11. In providing for a gravitation water supply, what characteristics would you look for in selecting the "collecting ground"? What supply per head would you advise, and how many days' storage as a minimum?
12. How is the operation of gauging a stream carried out? Give a formula for calculating the discharge over a weir.

SUBJECT:—BUILDING CONSTRUCTION, &c.

Examiner.—R. Vawser, M. Inst. C.E., Manchester.

1. Specify for Portland Cement, and describe the tests usual and necessary for its use in first-class work.
2. What are the characteristics of Hydraulic Lime?
3. Specify and describe in detail the best timber for Carpenters' and Joiners' Work in a good middle-class dwelling.
4. What is Dry Rot, how does it originate, how is it cured, and how prevented?
5. Describe in detail the materials used in various kinds of internal Plaster work, and state how they are prepared for use.
6. Specify for a Concrete Sewer, and describe the materials in detail.
7. What would guide you in the selection of the most suitable Brick, for constructive purposes?
8. Describe the special precautions you would take in erecting a Building on a formation of questionable character, and how you would construct the floors and foundations.
9. State the thickness of walls necessary in dwellings of various heights, and how you would fix the sizes of Breastsummers and Joists.
10. Describe various slates and tiles for Roofs, and the mode in which they are secured; and state the least pitch that should be allowed.
11. Specify for flat Lead and Zinc Roofing, give the weight thereof, and describe method of securing same.
12. Describe or sketch best arrangement for supporting the fireplace on the upper floors of buildings.
13. What is the strain on the tie rod of a Roof 60 feet span, selecting your own conditions as to pitch and covering of Roof?
14. What width of Street, and what other provision should you advise an urban authority to adopt, to secure a sufficient air space?

SUBJECT:—SANITARY SCIENCE.

Examiner.—E. B. Ellice-Clark, M. Inst. C.E., Sussex.

1. Enumerate the various Sections into which SANITARY SCIENCE is divided; as for instance—
   a. Water Works: For the sufficient supply of pure water.
   b. c. &c., &c.
2. Sketch the plan of a Ward for 12 Beds in an Infectious Diseases Hospital, showing—
   a. The position of each Bed.
   b. The necessary Closets and Sinks.
   c. The position of the Doors and Windows.
   d. Describe the means of Ventilation you would adopt; and
   e. The cubic space you would provide for each patient.

3. What are the essential differences between the Water-carriage system and the Dry Intercepting systems for the Disposal of Sewage?
   a. Describe generally, *in each case* (1) The forms of the Closets; (2) The respective positions, in relation to living rooms, which you would assign to them for a row of continuous Cottages, and
   b. The necessary arrangements for the disposal of the slop waters, ashes and garbage, in both systems.
4. State the advantages of the DRY INTERCEPTING SYSTEMS over the WATER-CARRIAGE SYSTEM or *vice versâ* (apart from financial considerations).
   Name the chief defects in each system respectively.
5. Mention some of the chief difficulties * that arise in the practical working of the WATER-CARRIAGE SYSTEM and the DRY INTERCEPTING SYSTEMS in such a town as Birmingham.
6. How would you test a stoneware-pipe drain, jointed in cement; laid in a new building; and connected with a 12-inch pipe Sewer in a public Street? to ensure—
   a. The soundness of each Pipe,
   b. The Soundness of the Joints,
   So as to determine whether the drain would be water-tight or not, in case of a stoppage near the Sewer.

   Describe the method of making the test and the means and appliances you would use in making the test.
7. What are the Advantages and Defects of the respective appliances shown below?
   In the case of a defective appliance, sketch or describe an appliance you would substitute.

*** *Here follow Sketches of*:—(*a*) *Pan Closet*, (*b*) *Long Hopper W.C.*, (*c*) *Wash-out W.C.* (*with "S" Trap*), (*d*) *Valve Closet*, (*e*) "*D*" *Trap*, (*f*) "*P*" *Trap*, (*g*) *Bell Trap*, (*h*) *Drain Syphons with and without "eye."*

SUBJECT:—PUBLIC HEALTH ACTS AND RIVERS POLLUTION ACTS.

Examiner.—J. Lobley, M.I.C.E., Borough Engineer, Hanley.

1. (*a*) State a few of the principal clauses of the Public Health Act, 1875, under which Notices can be served on owners of property and the work done by the Authority (on expiration of the notice in default of the owners) without further proceedings being first necessary. (*b*) Are there any series of clauses in the Act in which further proceedings are necessary (in such cases) before the work can be proceeded with by the Authority? (*c*) Are there any clauses in which no provision is made for the work being done by the Authority in default of the owners?
2. State the powers of the Authority with reference (*a*) to requiring work to be done in a private street, and (*b*) to the Authority adopting such

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* Not from a Constructive but from a Sanitary point of view.

street, that is declaring the same to be repairable by the inhabitants at large. (*c*) Supposing the majority of the owners of a private street were willing that a limited amount of work should be done, as for instance, forming and macadamizing the carriage-way and gravelling the footways; and the Authority were desirous for various reasons of complying with their wishes, what would be the legal position of the Authority with reference to (*a*) and (*b*)? (*d*) Describe the various steps to be taken by the Authority in dealing with such a street from first to last.

3. Under what circumstances can an Authority construct a new sewer (not in a private street) and charge the owners of house property thereby drained with the cost? State the courses to be taken by the Authority.
4. State the provisions of the Act on the following points:—(*a*) Dangerous buildings; (*b*) dangerous places; (*c*) improving the line of existing public streets; (*d*) under what circumstances have the Authority compulsory powers to take land to improve public streets? (*e*) State the course to be taken to acquire such powers.
5. What are the main provisions of the Rivers Pollution Act?

Twenty candidates presented themselves for examination, of whom the following twelve satisfied the Examiners and were granted their certificates of competency:—

G. Ball (Scarborough).
E. T. Beard (Lincoln).
C. Brownridge (Leeds).
J. A. Crowther (Leeds).
M. W. Jameson (Leeds).
T. Mallinson (Selby).
J. S. Pickering (West Bromwich).
E. J. Silcock (Leeds).
E. Sykes (Reddish).
R. J. Thomas (Carnarvon).
V. H. Turner (Leeds).
Wm. Young (Pendleton).

THIRD EXAMINATION.

The Third Examination was held at the Institution of Civil Engineers, Westminster, S.W., on Thursday and Friday the 22nd and 23rd April, 1887, when the following Examination Papers were set to the candidates.

Subject:—Engineering as Applied to Municipal Work.

W. Geo. Laws, M.I.C.E., Examiner.

1. How are the lines of a chain survey fixed in position, and how is the correctness of the work tested? What is meant by "tying" the lines? Give a sketch.

2. How would you find the relative levels of a sloping field, say for laying it out for streets? What instruments are used, and how?
3. What is a siphon, and how may it be used in carrying water from one side of a dam to the other? What conditions are essential to its action? Give any instance you know of its use in main drainage.
4. What is meant by "Hydraulic Mean Depth," and how is it calculated? What is the H.M.D. of a trough 12 inches square running full?
5. Describe the mode of "laying" and jointing an ordinary street sewer pipe, and the use of "boning rods" in securing uniform fall therein.
6. Sketch and describe an approved manhole and its proper position and uses in a system of sewers.
7. When are brick sewers to be preferred to pipes, and what is their best shape? Sketch section of and specify very briefly for a length of brick sewer.
8. Describe and illustrate the mode of forming a reservoir dam, shewing how it is made water-tight, and the precautions to be taken against leakage, and damage by overflow.
9. Calculate the strain per square inch on the metal of a pipe four inches diameter, and one half-inch thick, under a head of 300 feet of water-pressure.
10. Mention some of the chief systems of wood paving. Specify briefly for one of them, and state where it is applicable, and why.

SUBJECT:—BUILDING CONSTRUCTION, &c.

E. B. Ellice-Clark, M.I.C.E.,
H. P. Boulnois, M.I.C.E., } *Examiners.*

1. Under what conditions would you construct **Inverted Arches** in a building—and what purpose do they serve?
2. Sketch some different forms of **Dowels** used in masonry.—Show the position of a **Kneestone** in a wall.
3. Under what conditions would you lay masonry or concrete blocks in **Diagonal Bond**?
4. State **Tredgold's**, or other rule, with diagram, for **proportioning** the various **parts** of a **Scarf** [having regard to the strength of different timbers] to resist **tensional, compressional,** or **shearing force** respectively?
5. What **considerations** determine the **form** of **truss** or **principal** for a **roof** of a given span?
6. Sketch the **principal** of a **roof,** not iron, for a span of **26 feet,** where a **tie-beam is inadmissible**?
7. What do you consider the best **method of forming a fire-proof** floor for a warehouse? State the **advantages** and **disadvantages** of **arched floors.**
8. What is meant by sheet lead "Crawling," and under what conditions will this happen?
9. Write a short Specification for flat roof to be covered with zinc, giving such sketches as you consider necessary.

SUBJECT:—SANITARY SCIENCE.

Lewis Angell, M. Inst. C.E., Fellow King's Coll., London, Examiner.

1. What are the component parts of—

   (*a*) Pure Atmospheric Air?
   (*b*) Pure Water?

   What are the usual sources of contamination in a Dwelling House?
2. How many cubic feet should be allowed for each Adult in a Sleeping Room?
3. What natural conditions and structural precautions are necessary to secure a healthy site for a Dwelling?
4. Sketch a section of a House of three stories, showing—

   (*a*) A sink on ground floor.
   (*b*) W.C. and Bath on first Floor.
   (*c*) W.C. on third floor,

   and show, distinctly, the water tanks and entire method of drainage, trapping, sewer connection, and ventilation.
5. What proportion in sectional area should the ventilating pipe above a W.C. bear to the soil pipe below?
6. Describe a practical test to discover any hidden defects in a House drain as to jointing, trapping, &c.
7. For what quantity of rainfall in 24 hours is it usual to provide in a main sewer, and how many cubic feet per head of the population would you provide for in a water-carried system of sewerage?
8. State the advantages and disadvantages of a duplicate system of drainage for the separation of rainfall from the sewage.
9. State, generally, what are the methods adopted for the purification of sewage at the outfall, and describe some one chemical process, its mode of operation and results.

SUBJECT:—PUBLIC HEALTH ACTS AND RIVERS POLLUTION ACTS.

Joseph Lobley, M. Inst. C.E., Examiner.

1. (*a*) State the difference under the Public Health Act, 1875, between a sewer and a drain. (*b*) Supposing a sewer existed in a street (which is not a highway repairable by the inhabitants at large), under what circumstances would that sewer be vested in the Local Authority? and (*c*) how would that effect the power of the Authority to require the owners to construct a new sewer?
2. What proceedings are necessary before a Local Authority can proceed to construct a sewer without their district?
3. (*d*) Is a Local Authority obliged to remove house refuse from premises and to cleanse privies and ashpits? (*e*) Under what circumstances is a Local Authority liable to a penalty for non-removal? (*f*) What is the amount of the penalty?
4. (*g*) Does the Public Health Act, 1875, provide any means whereby a person

suffering from the existence of a nuisance caused by an offensive trade being carried on in his neighbourhood can obtain redress without the consent of the Local Authority being required? (*h*) Give particulars as to the mode of proceeding.

5. Respecting the making of a new road or street within the district of a Local Authority.

   State what proceedings are necessary, as, for instance, majority requisite at a meeting of the Authority, application to Local Government Board or Parliament before the Local Authority can make (*j*) one, (*k*) contribute to the cost of one, (*l*) acquire land to make one with the consent of the owners, (*m*) acquire land to make one without the consent of the owners.

6. State the requirements of the Act with reference to contracts. (*n*) What amount can a Committee be delegated to accept? (*o*) At what amount must the agreement be in writing? (*p*) Under what circumstances must advertisements for tenders be made public?

7. State shortly the necessary proceedings by a Local Authority against a manufacturer who, in contravention to the Rivers Pollution Act, pours polluted liquid into a watercourse, such polluted water not being admissible into the sewers of the Local Authority.

On this occasion there were twenty-one entries, and nineteen presented themselves for examination, of whom the following nine candidates satisfied the Examiners and were granted their certificate of competency:—

C. Adcock (Liverpool).
F. E. Cooper (Liverpool).
Hy. Dearden (Leeds).
T. W. Franks (West Bromwich).
A. E. Nichols (Leeds).
F. J. Nickols (Leeds).
E. W. Rich (Hounslow).
J. Saunders (Newark).
B. Verschoyle (Liverpool).

BOARD OF EXAMINERS.

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CANDIDATES WHO HAVE PASSED THE EXAMINATION.

Date of Certificate.		
May 7, 1887	..	Adcock, C. (Liverpool).
May 1, 1886	..	Angell, J. A. (Leytonstone).
May 1, 1886	..	Ashmead, H. (Clifton).
Oct. 16, 1886	..	Ball, G. (Scarborough).
Oct. 16, 1886	..	Beard, E. T. (Lincoln).
Oct. 16, 1886	..	Brownridge, C. (Leeds).
May 1, 1886	..	Coales, H. G. (King's Lynn).
May 7, 1887	..	Cooper, F. E. (Liverpool).
Oct. 16, 1886	..	Crowther, J. A. (Leeds).
May 7, 1887	..	Dearden, Hy. (Leeds).
May 1, 1886	..	Fenton, W. C. (Sheffield).
May 7, 1887	..	Franks, T. W. (West Bromwich).
May 1, 1886	..	Greatorex, A. D. (Toxteth Park).
May 1, 1886	..	Harland, A. (London).
Oct. 16, 1886	..	Jameson, M. W. (Leeds).
Oct. 16, 1886	..	Mallinson, T. (Selby).
May 7, 1887	..	Nichols, A. E. (Leeds).
May 7, 1887	..	Nickols, F. J. (Leeds).
May 1, 1886	..	Osborne, F. (Dover).
Oct. 16, 1886	..	Pickering, J. S. (West Bromwich).
May 7, 1887	..	Rich, E. W. (Hounslow.)
May 1, 1886	..	Saunders, E. E. (Walthamstow).
May 7, 1887	..	Saunders, Jas. (Newark).
Oct. 16, 1886	..	Silcock, E. J. (Leeds).
Oct. 16, 1886	..	Sykes, E. (Reddish).
Oct. 16, 1886	..	Thomas, R. J. (Carnarvon).
Oct. 16, 1886	..	Turner, V. H. (Leeds).
May 7, 1887	..	Verschoyle, B. (Liverpool).
May 1, 1886	..	Witts, J. W. (Skelton).
Oct. 16, 1886	..	Young, Wm. (Pendleton).

Memoirs of Deceased Members.

The Council, having been requested to append some short notice of the decease of Members of this Association, will feel obliged by early notice being forwarded to the Secretary, with such particulars as it may be desirable to insert in these 'Proceedings.'

Mr. William Whittington, Borough Surveyor, Neath, Glamorganshire, died on the 29th April, 1886. Mr. William Whittington was born at Tonna, near Neath, in June 1840, and was the eldest son of the late Mr. Mathew Whittington, and the grandson of the late Mr. William Whittington, who for many years held the office of County Surveyor for Glamorganshire. Grandfather, father, and son were members of the same profession. Mr. Whittington, jun., was educated at Carmarthen College, and in 1856 was articled as a mining and civil engineer to Mr. Wm. Struvé, M. Inst. C.E., then engineer to the Cwmavon Works and Collieries. Mr. Whittington remained at Cwmavon until 1865, both as pupil and as assistant to Mr. Struvé. In that year he commenced practice on his own account as a mining and civil engineer at Church Place, Neath. In April 1873 he was appointed Borough Surveyor and Sanitary Inspector of Neath, and he continued to act in that capacity, as well as to carry on an extensive private practice, up to the time of his death. Mr. Whittington successfully carried out extensive works of sewerage and street improvements for the Neath Corporation. He was also engineer for the Neath and District Tramways, for the Oystermouth and District Waterworks, and for other undertakings. He was an Associate Member of the Institute of Civil Engineers. It is no mere platitude to say that Mr. Whittington's death is truly mourned by all who knew him, and by those who were intimately associated with him. The memory of his sterling worth, his unpretentious goodness of heart, and kindliness of spirit will ever be warmly cherished.

JOHN GREEN HALL, F.R.I.B.A., City Surveyor of Canterbury, died on the 17th May, in the 52nd year of his age. Mr. Hall was a native of Hampshire, and went to Canterbury on receiving the appointment of City Surveyor in 1866, when he was elected out of over sixty candidates. He was a Fellow of the Royal Institute of British Architects since 1882, and Associate of the Institution of Civil Engineers since 1877. His chief architectural works in Canterbury were the cemetery buildings, the Roman Catholic Chapel, the Presbyterian Chapel, and his latest works were the Masonic Temple and the London and County Bank. The new bank buildings now being erected for Messrs. Hannson and Co., from his designs and plans, are spoken of as being probably his most important architectural effort in the neighbourhood of Canterbury. He had, however, been architect of churches and other buildings in Yorkshire and elsewhere. His plans for the sewage works on the Sturry Road, Canterbury, and the system of filtration which he adopted, possessed marked originality; and although the site of the works presented many difficulties, the sewage farm has more than realised the expectations formed of it. Mr. Hall always looked on this as his best professional achievement. He was incessant in his attention to the works until the experience of the first years had proved the success of the system. At the time of his fatal illness he was engaged as engineer of the drainage works at Edenbridge, and had just prepared a scheme for waterworks for the town of Sandwich. In his private capacity he was respected and esteemed by a wide circle of friends. The interment took place in the Canterbury Cemetery on the 20th inst., the funeral being attended by the members of the Corporation, of the local lodge of Freemasons, and a large number of the leading citizens.

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PROCEEDINGS
OF
THE ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.

CONTENTS OF VOLUME XI.

PAPERS AND DISCUSSIONS:

THE ORIGIN, CONSTITUTION, AND OBJECTS OF THE ASSOCIATION OF MUNICIPAL AND SANITARY ENGINEERS AND SURVEYORS.—L. Angell.
SANITARY LEGISLATION AND ITS ENFORCEMENT.—Prof. H. Robinson.
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REMOVAL OF HOUSE REFUSE.—R. Godfrey.
THE LEYTON SEWAGE WORKS.—W. Dawson.
THE IMPROVEMENT OF THE RIVER TEES.—Sir J. Fowler.
THE MAIN DRAINAGE WORKS AT COLCHESTER.—Chas. Clegg.
DOMESTIC WATER-SUPPLY FROM SHALLOW WELLS.—E. G. Mawbey.
SOME ACCOUNT OF THE PUBLIC WORKS IN TORQUAY.—J. Hall.
SEWERING TOWNS ON THE SEPARATE SYSTEM.—T. Hewson.
LEEDS SEWAGE WORKS—EXPERIMENTS IN PURIFICATION—T. Hewson.
ON VARIOUS WORKS IN CONNECTION WITH THE BOROUGH OF BURNLEY.—[J. E. Stafford.
THE VICTORIA HOSPITAL, BURNLEY.—J. A. Waddington.
SOME ADVANTAGES AND RESULTS OF THE SUPPLY OF WATER BY METER FOR DOMESTIC CONSUMPTION.—G. Winship.
FIVE YEARS' MUNICIPAL WORK IN NOTTINGHAM.—A. Brown.
PRESIDENT'S ADDRESS.—R. Vawser.
STREET LIGHTING.—W. S. Crimp.
SANITARY GAS MAKING.—Professor Wanklyn.
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DANGEROUS STRUCTURES.—Sidney G. Gamble.
ON THE WASTEFULNESS OF IGNORANCE AND ECONOMY OF SCIENCE.—[E. Chadwick.

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SOME PARTICULARS OF THE MUNICIPAL AND SANITARY WORKS OF BLACKBURN.—J. B. McCallum.
THE RISE AND PROGRESS OF BOURNEMOUTH AND THE PUBLIC WORKS IN CONNECTION THEREWITH.—G. R. Andrews.
STRATFORD-UPON-AVON WATER SUPPLY.—J. Edward Willcox.
STRATFORD-ON-AVON SEWERAGE AND SEWAGE DISPOSAL.—Alfred T. Davis.
DESCRIPTION OF THE CAST-IRON CYLINDER FOUNDATION FOR A QUAY WALL IN THE RIVER TYNE AT GATESHEAD.—Jas. Bower.
THE EFFICIENT DISCONNECTION OF SLOP-STONE PIPES.—Cosmo C. Hooley.
MUNICIPAL WORK IN BRADFORD.—J. H. Cox.
GREAT YARMOUTH, AND SOME OF THE RECENT WORKS OF ITS SANITARY AUTHORITY.—J. W. Cockrill.
THE SEWERAGE, SURFACE DRAINAGE, SEWAGE DISPOSAL, AND HOUSE DRAINAGE OF THE MARKET HARBOROUGH, GREAT AND LITTLE BOWDEN LOCAL BOARD DISTRICT.—E. G. Mawbey.
PRESIDENT'S ADDRESS.—J. Lobley.
NOTES ON RECENT SEWAGE OPERATIONS IN NOTTINGHAM AND ITS NEIGHBOURHOOD.—M. Ogle Tarbotton.
THE PRESENT ASPECT OF THE RURAL ROAD QUESTION, WITH SOME REMARKS ON THE MAINTENANCE OF MACADAMISED ROADS, &c.—E. B. Ellice-Clark.
THE ECONOMIC PRODUCTION OF COAL GAS.—R. P. Spice.
ROAD-WATERING.—W. Santo Crimp.
THE REFUSE DESTROYER AT NELSON.—W. Dent.
THE PUBLIC SUPPLY OF ELECTRICITY IN TOWNS AS AN ILLUMINANT.—J. N. [Shoolbred.
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